

# Work Plan

## **Site Assessment Syracuse, New York**

Prestolite Corporation  
Syracuse, New York

July 1985



**O'BRIEN & GERE**

Meeting at Syracuse 9/10/85

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WORK PLAN  
SITE ASSESSMENT  
SYRACUSE, NEW YORK

PRESTOLITE CORPORATION  
SYRACUSE, NEW YORK

O'Brien & Gere Engineers, Inc.  
July 1985

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# Introduction




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## INTRODUCTION

The Syracuse facility of Prestolite manufactures and assembles D.C. motors. Historically, plating, anodizing and heat treating of metals were part of the plant operations. Industrial wastes generated by these operations include water-soluble coolants, waste oils, metal sludges and other metal finishing wastes. Conversations with long-time employees of the plant indicate that some of the waste materials may have been disposed of on-site. Additionally, available documents and aerial photographs reveal that the Eastwood Sewage Treatment Plant occupied portions of the plant property prior to 1960.

A total of twelve (12) areas have been identified by Prestolite as potential areas impacted by historical site operations. These areas, shown on Figure 1, are identified as follows:

- A. Obsolete Waste Treatment Plant: Four tanks, 20 feet deep, were formerly used for treatment of plating wastes. These operations were terminated around 1967-1969, but the plant has never been formally decommissioned. The tanks are filled with 10 feet of gravel, but may also contain waste residuals. Water elevations in the tanks appear to fluctuate seasonally, suggesting a possible link to the groundwater table. There is also several feet of standing water within the basement of the adjacent treatment building.
- B. It has been alleged that the waste treatment tanks occasionally overflowed to adjacent grounds. Residuals may remain in the soils.
- C. Adjacent to the south parking lot is an area where it is alleged that local residents disposed of domestic refuse.

- D. A drainage ditch along the west plant boundary is currently used for storm and roof drainage runoff. However, water soluble coolants (containing fats and phenolics) were alleged to have been discharged to this ditch and may have leached into the soils.
- E. Within the lawn to the north of the plant is an area where grass is unable to grow. This is the site of an old castings dump and part of the Eastwood Sewage Treatment Plant as described in construction documents.
- E". Two unnatural depressions and evidence of a concrete tank or foundation suggest that this area may be the location of the old Eastwood Sewage Treatment Plant Imhoff Tanks.
- F, G & J  Parking Lot Annex - an area in which fill was placed and waste materials may have been deposited. Site J may also be an area which was once part of the Eastwood Sewage Treatment Plant.
- H. It is alleged that spillage and disposal at the loading dock area has occurred in the past. These liquids may have drained north and seeped into soil at the edge of the pavement. Coolants and waste oils may have been involved.
- I. Within the wooded area to the north, several 55-gallon drums which appeared to be many years old, were recently noticed. These drums contained a solid, resin-like material. No liquids were evident. It is suspected that a neighboring industry may have used this area for waste disposal at one time.
- K. Area near the old heat treating area. Conversations with employees indicate that furnace waste may have been discarded in this area.

### Objective

The objective of this investigation is to determine the presence and nature of any contamination in the soil or groundwater as a result of past disposal practices at the Prestolite facility or site activities prior to Prestolite's acquisition of the property. If contaminants are found to be present, a program for the evaluation of possible human health/environmental impacts will be developed and a program for review of remedial actions will be recommended.



# Work Plan



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## SAMPLING/ANALYSIS PLAN

The sampling/analysis plan developed for the Prestolite facility reflects the information gathered from Prestolite personnel and available records. This plan will provide information which will be used to characterize all of the areas within the site property which have been defined to be potential disposal or spill areas. The sampling points are shown on Figure 2. Sites C and I will not be sampled during this phase of the site investigations pending further investigations into the types of materials and parties involved in disposal of waste in these areas.

### Site A: Waste Treatment System: Tank & Basement Sampling

It is desirable to sample the bottom sediments and the gravel within the four waste treatment system tanks to determine the characteristics of these materials for determination of disposal alternatives. The exact nature of the materials within the tanks is not known at this time, however, two potential methods of sampling these materials are proposed. One method would involve driving a 4" diameter casing and cleaning out the inside of the casing to a depth close to the bottom of the tank at which point a sample for analysis would be collected. The other method would require the use of a specialized sampling instrument which is similar to a split-barrel sampler with an approximate diameter of 3/4". This sampling instrument would be driven with a hammer to the depth at which a sample is desired. The plug would then be removed and the sample would be collected for analysis. The success of these two methods is questionable as the nature of the material

within the tanks is presently unknown. For cost-estimate purposes, however, the latter method will be used.

A sample of the sediments on the basement floor of the waste treatment plant will also be collected. The sample method used for this task will be similar to that used for the shallow soil samples and dependent upon the amount of water in the basement at the time of sampling.

### Soil Sampling

Shallow and deep soil samples will be collected at the Prestolite facility. All of these samples will be collected in accordance with EPA sampling methods defined in Samples and Sampling Procedures for Hazardous Waste Streams (EPA-600/2-80-018).

Shallow soil samples will be collected in areas B, D, H and the parking lot annex (including Sites F, G and J). The shallow soil samples will be collected using either a trowel, lexan tubing or a comparable instrument. The exact depths of each sample will be determined based on visual observations in the field. The estimated depth is between 1 and 3 feet below the surface.

Deep soil samples (estimated to be between 5 and 10 feet) are proposed in Areas H, E, E' and K as well as the parking lot annex. These deep samples have been selected to best represent areas of buried wastes identified during the historical data review since filling may have occurred subsequent to the disposal activities.

The deep soil samples will be collected using standard hollow stem auger drilling and split-barrel sampling method ASTM-D-1586-67. The samples will be collected continuously to the base of the landfill (estimated to be 20 feet thick). The collected soil samples will be

screened with an HNU Photoionization Analyzer (HNU Systems, Inc. Model P-1-101) immediately after each split-barrel sampler is opened. Up to two samples from each soil boring will be selected for analysis based on the HNU screening and visual observations. The samples selected for analyses will be packaged in accordance with the procedures outlined in EPA-600/2-80-018. Upon collection of each sample, the split-barrel sampler will be decontaminated in accordance with the decontamination procedures.

#### Observation Well Installations

Five wells will be installed within the overburden material in the vicinity of the Prestolite facility. One well will be installed upgradient and four wells will be installed downgradient of the plant (See Figure 2). These wells will be used to better define the groundwater flow direction and determine the groundwater quality to assess possible impacts on the groundwater due to site activities.

The upgradient well will be installed to an estimated depth of 25 feet. The downgradient wells are estimated to be 15 feet deep. The test borings for the wells will be completed using standard hollow stem auger drilling methods and split-barrel sampling method ASTM-D-1586-67. Soil samples will be collected at five foot intervals.

The wells will be constructed of a 10-foot length of 2-inch I.D., .010-inch slot, PVC well screen and attached 2 inch I.D. PVC riser casing with a vented cap.

The screen and riser assembly will be placed to the bottom of the completed borehole. A washed, graded sand will be placed around the

screen and extended 2 feet above the top of the screen. A 2-3 feet thick bentonite pellet seal will be placed above the sand pack and the remaining annulus will be filled with a bentonite/cement grout to within 2 feet of the ground surface. A 4-6 inch diameter locking steel casing will then be placed over the well and cemented in place.

#### Well Development

Each of the wells will be developed after a minimum of 24 hours has elapsed since completion of the well installation. An air surging method or bailing will be used for the development. This procedure will continue until each well yields sediment free water. Water levels will be measured before and after the development process.

#### Decontamination

All drilling equipment and associated tools, including augers, drill rods, sampling equipment, wrenches and any other equipment or tools that have come in contact with sampled materials shall be decontaminated using high pressure detergent steam cleaning equipment and followed by a clean water rinse. The water used for decontamination shall be obtained from a controlled water source such as a municipal drinking supply.

#### Well and Sample Location Survey

All well and sampling points will be surveyed to establish their location and elevation. In addition, selected spot locations and elevations will be surveyed for preparation of a non-topographic site map.

The survey will be based on a previously established benchmark located at the site.

#### Tank and Basement Sample Analyses

The samples collected from the tank bottoms and the basement of the Wastetreatment Plant may contain residuals from the waste treatment system. These samples will be analyzed for PCB, Metals, Oil and Grease, Cyanide (Total and Amenable) and Phenols. In addition to these analyses, samples from Tanks 1 and 2 will be composited and analyzed for Volatile Halogenated Organics.

#### Groundwater Sampling Analysis

Groundwater samples will be collected from each of the four wells in accordance with O'Brien & Cere's sampling protocol (attached). All samples will be analyzed for full EPA priority pollutants in accordance with accepted EPA Protocols as defined in Federal Register Volume 49, Number 209; October 26, 1984.

#### Soil Sample Analysis

A number of plant related wastes and possibly associated materials have been identified by Prestolite personnel as potentially having been disposed of on-site. The constituents of these wastes may include the following:

- Metals
- Phenols
- Cyanide

- Organic Solvents (Trichloroethylene, Perchloroethylene)
- PCB
- Oil and Greases

The analysis parameters for the soil samples were selected to reflect the above waste materials. Table I summarizes the analysis parameters selected for the individual areas of concern.

The metals analyses selected to best represent wastes produced at a metal finishing and fabrication facility are as follows:

EP TOX Metals

Arsenic  
Barium  
Cadmium  
Chromium (Hexavalent)  
Lead  
Mercury  
Selenium  
Silver

Additional Metals

Chromium (Total)  
Copper  
Nickel  
Tin  
Zinc

The metals analyses will be Total Metals. Based on the results of the Total Metals analyses, it may be desirable to analyze select samples for Extractable Metals at a later date. For cost estimate purposes only Total Metals analyses are considered.

It may be desirable to conduct additional analyses on selected samples based on the results of the first round of analyses. To avoid the necessity for recollection of the soil and tank samples, the balance of each sample will be preserved after completion of the first set of analyses until the necessity of further analysis has been determined.

TABLE 1  
SAMPLING/ANALYSIS PLAN

<u>Sample Location</u>	<u>Number of Samples</u>	<u>Analyses Required</u>	<u>Analysis Costs</u>
Site A (Tanks 1-4) and Basement	5	PCB Volatile Halogenated Organics (Tank 1 and 2 composite) Metals Cyanide (Total and Amenable) Phenols Oil & Grease	\$ 2,387.50
Site B	4	PCB Volatile Halogenated Organics Metals Cyanide (Total and Amenable) Phenols Oil & Grease	\$ 2,102.00
Site D	2	PCB Volatile Halogenated Organics Metals Cyanide (Total and Amenable) Phenols Oil & Grease	\$ 1,051.00
Site E	1	Metals Cyanide (Total and Amenable) PCB	\$ 393.50
Site E'	3	Metals Oil & Grease	\$ 730.50
Parking Lot ANNEX (including sites F, G & J)	15	PCB Volatile Halogenated Organics Metals Cyanide (Total and Amenable) Phenols Oil & Grease	\$ 7,882.50
Site H	3	PCB Volatile Halogenated Organics Metals Cyanide (Total and Amenable) Phenols Oil & Grease	\$ 1,576.50
Site K	1	PCB Volatile Halogenated Organics Metals Cyanide (Total and Amenable) Phenols Oil & Grease	\$ 525.50
Monitor Wells	5	Priority Pollutants	\$ 8,500.00 \$25,149.00



### Review of Water Uses

Potable water sources, both surface water and groundwater, in the vicinity of the site will be identified. Additionally, any local groundwater or surface water users in the area will be located.

This proposal covers only the work items enumerated in Phase I above. Subject to the conclusions developed as a result of Phase I, it may be necessary to perform additional work as part of later phases. Specific recommendations will be offered at the conclusion of Phase I.

### Evaluation and Recommendations

The individual sites will be evaluated based on the collected geologic and chemical data. Additionally, the groundwater quality and flow direction in the site area will be assessed.

The field data, analyses and assessments will be reviewed and a draft report will be prepared for review by Prestolite. Subsequent to Prestolite's review, a meeting will be arranged to discuss the results and present recommendations for further work efforts as necessary. A final report will then be prepared incorporating any revisions discussed at the meeting.

### Coordination Meetings

It is recommended that this work plan be reviewed with NYSDEC for concurrence. If this situation occurs and Prestolite wishes to negotiate a final work plan it will be necessary to arrange a meeting for discussion. For the purpose of costs it is assumed that a meeting will be held in the Syracuse area requiring the attendance of two O'Brien & Gere personnel.

## PROJECT MANAGEMENT

### Project Team

O'Brien & Gere has a staff of over 350 professional, technical and support personnel. A wide range of both traditional and specialized engineering services needed to address the complex issues involved with hazardous waste management are presented on the staff.

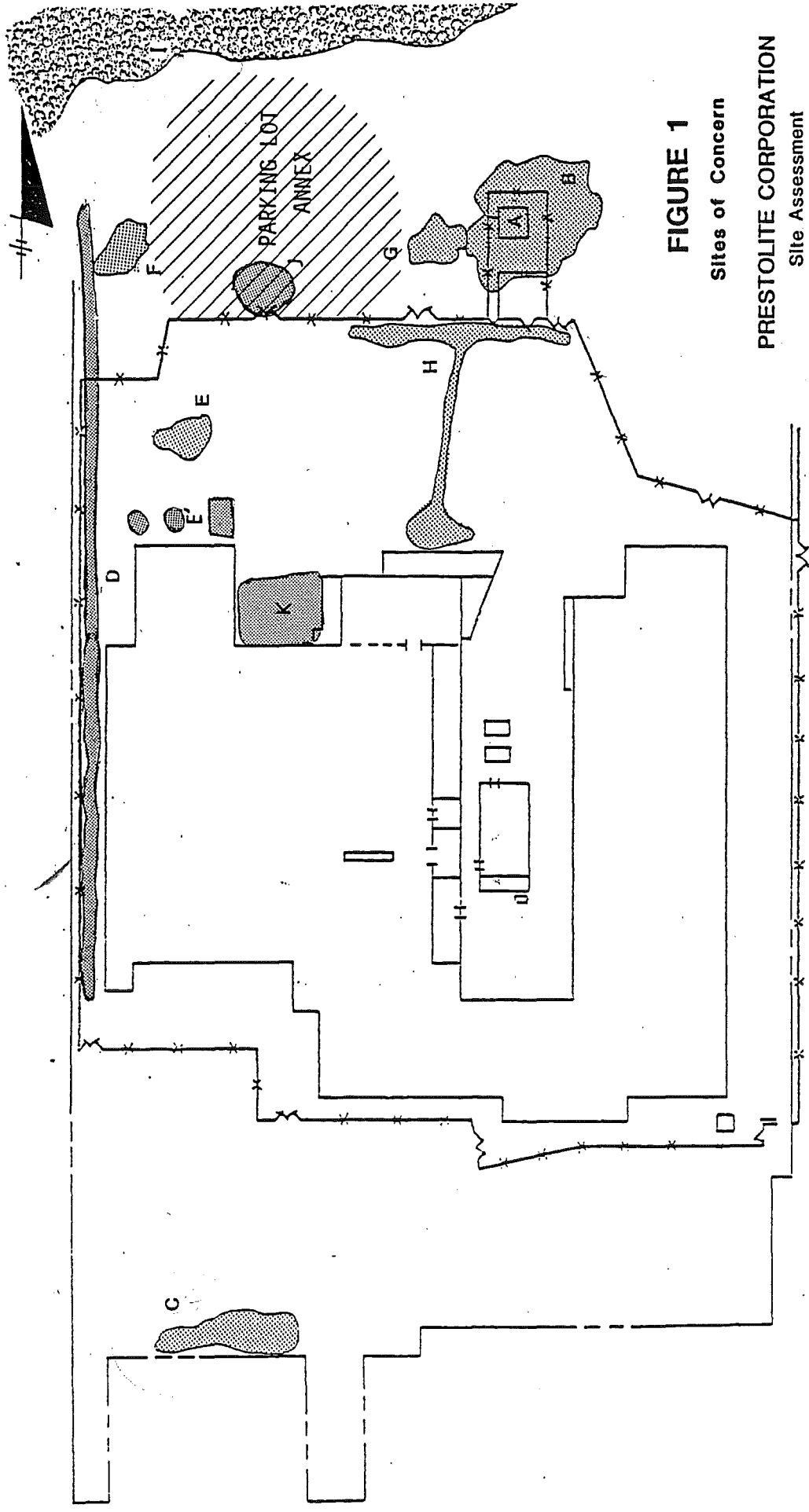
For any given project it is O'Brien & Gere's policy to formulate a project team comprised of those individuals who can provide the required experience and expertise required for that specific project. The project team formed for the Prestolite project follows this policy. Changes in the key personnel for this project will not be made without notification or approval of Prestolite.

The project team developed for this project will be directed by Steven R. Carver, P.E. Mr. Carver will coordinate the efforts of the engineers, geologists and chemists to ensure that the work effort provides information acceptable to Prestolite. Mr. James Mickam will manage those aspects of the project involving site hydrogeology and geophysical testing. Mr. Mickam will be assisted by several other hydrogeologists including Guy Swenson, Deborah Wright and Robert Foresti. Dr. Swiat Kaczmar will assist with the contaminant characterization and transport assessments as required. Other project personnel include Frank Hale and Andrew Irwin. Resumes of these professional personnel have been forwarded in the previous proposals. All of the project staff have extensive experience with site investigation or chemical substance control programs. Laboratory analyses will be conducted by O'Brien & Gere's laboratory which is accredited by NYSDEC for analyses at CERCLA-regulated sites.

# Figures



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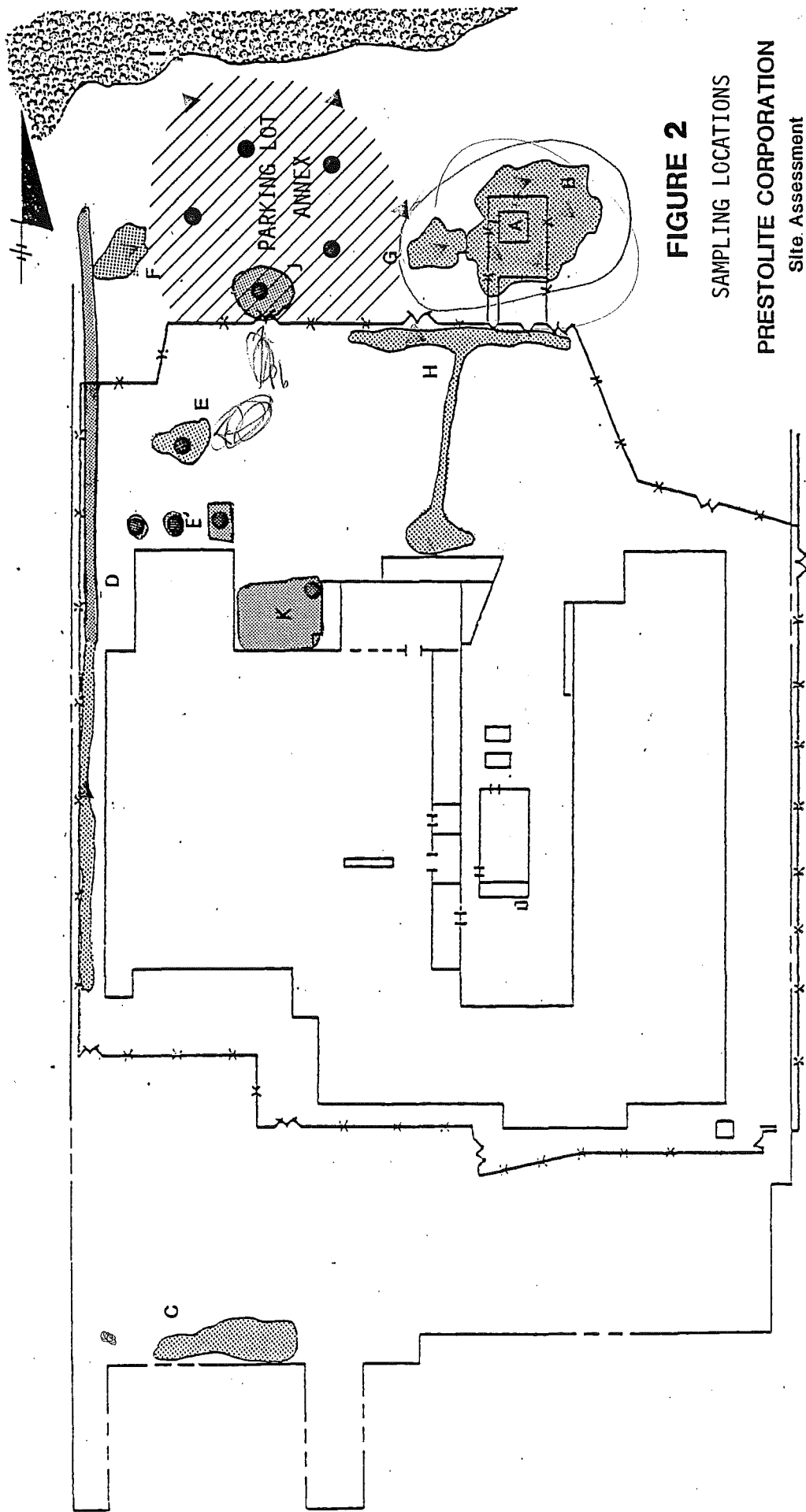


**FIGURE 1**

Sites of Concern

PRESTOLITE CORPORATION  
Site Assessment





**FIGURE 2**

SAMPLING LOCATIONS

PRESTOLITE CORPORATION

Site Assessment

**LEGEND**

- Deep Soil Sample
- ▲ Shallow Soil Sample





**FIGURE 3**

MONITOR WELL LOCATIONS

**PRESTOLITE CORPORATION**

Site Assessment

LEGEND



Monitor Well  
(location approximate)



# Sampling Protocols



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## GROUNDWATER SAMPLING PROCEDURES

### I. MATERIALS

1. Hard hats
2. Disposable gloves
3. Disposable overalls
4. Disposable shoe covers
5. Dual carbon respirators with appropriate filters
6. Safety glasses or goggles
7. Plastic sheeting (10 ft by 10 ft minimum)
8. Bailer (top filling) 1-1/2 inch I.D. stainless steel
9. Polypropylene rope
10. Distilled water
11. Acetone solvent
12. Clean disposable towels
13. Well depth probe
14. 100' cloth tape
15. Submersible pump with accessories
16. Rinsing basins
17. Graduated pail
18. Conductivity meter
19. pH meter
20. Appropriate sampling containers
21. 200 ml beaker
22. Insulated transport containers

### II. GENERAL NOTES

The following general notes must be adhered to during all well developing and sampling operations:

1. Hard hats and rubber boots must be worn on site at all times.
2. Safety glasses or goggles must be worn at all times during well development or sampling to prevent splashing of potentially contaminated water into the eyes.
3. Respirators must be worn if a distinct chemical odor is observed.
4. Sampling of wells must be discontinued during precipitation periods (rain or snow).



### III. GROUNDWATER WELL DEVELOPMENT

Prior to obtaining groundwater samples for laboratory analysis, all monitoring wells must be developed as described in the following paragraphs:

To obtain representative samples of groundwater from a groundwater monitoring well, all fine grained material and sediments that have settled in or around the well during installation should first be removed from the well (well development). This is accomplished by air surging, pumping or bailing groundwater from the well until it yields relatively sediment-free water.

The following precautions are taken to avoid cross-contamination of the wells during development. All equipment shall be cleaned after each use. Pumps or bailers are washed with tap water, and rinsed with acetone solvent and distilled water. All disposable accessories such as polypropylene tubing and hose used for air surging, or polypropylene rope used for bailing are replaced between wells. NOTE: Wells developed by air surging must be allowed to stabilize after development a minimum of ten (10) days prior to sampling. Wells developed by bailing or pumping must be allowed to stabilize after development a minimum of one (1) day prior to sampling.

### IV. PROCEDURES

Use of the following procedures for the sampling of groundwater observation wells is dependent upon the size and depth of the well to be sampled and the volume of groundwater in the well. To obtain representative groundwater samples from wells containing only a few gallons of groundwater, the bailing procedure is preferred. To obtain

representative groundwater samples from wells containing more than a few gallons, the pumping procedure generally facilitates more rapid sampling. Each of these procedures is explained in detail below.

A. Sampling Procedures (BAILER)

1. Identify the well and record the location on the Groundwater Sampling Field Log, Attachment A.
2. Put on a new pair of disposable gloves.
3. Cut a slit in the center of the plastic sheet, and slip it over the well creating a clean surface onto which the sampling equipment can be positioned. This clean working area should be a minimum of 10 feet by 10 feet.
4. Clean all meters, tools, equipment, etc., before placing on the plastic sheet.
5. Disposable shoe covers should be placed over the samples shoes to prevent potential contamination from dirty shoes contacting the plastic sheet. Do not kick, transfer, drop, or in any way let soils or other materials fall onto this plastic sheet unless it comes from inside the well.
6. Clean the well cap with a clean towel, and remove the well cap, and plug placing both on the plastic sheet.
7. Using a well probe, measure the depth to the water table and the bottom of the well. Record this information in the Groundwater Sampling Field Log.
8. Clean the well depth probe with an acetone soaked towel and rinse it with distilled water after use.
9. Compute the volume of water in the well, and record this volume on the Groundwater Sampling Field Log.

10. Attach enough polypropylene rope to a bailer to reach the bottom of the well, and lower the bailer slowly into the well making certain to submerge it only far enough to fill it one-half full. The purpose of this is to recover any oil film, if one is present on the water table.

11. Pull the bailer out of the well keeping the polypropylene rope on the plastic sheet. Empty the groundwater from the bailer into a new glass quart container and observe its appearance.

NOTE: This sample will not undergo laboratory analysis, and is collected to observe the physical appearance of the groundwater only.

12. Record the physical appearance of the groundwater on the Groundwater Sampling Field Log.

13. Lower the bailer to the bottom of the well, and agitate the bailer up and down to resuspend any material settled in the well.

14. Initiate bailing the well from the well bottom making certain to keep the polypropylene rope on the plastic sheet. All groundwater should be dumped from the bailer into a graduate pail to measure the quantity of water removed from the well.

15. Continue bailing the well from the bottom until three (3) times the volume of groundwater in the well has been removed, or until the well is bailed dry. If the well is bailed dry, allow sufficient time for the well to recover before proceeding with Step 14. Record this information on the Groundwater Sampling Field Log.

16. Remove the sampling bottles from their transport containers, and prepare the bottles for receiving samples. Inspect all labels to insure proper sample identification. Sample bottles should be kept cool with their caps on until they are ready to receive samples. Arrange the sampling containers to allow for convenient filling. Always fill the containers labeled purgeable priority pollutant first.
17. To minimize agitation of the water in the well, initiate sampling by lowering the bailer slowly into the well making certain to submerge it only far enough to fill it completely. Fill each sample container following the instructions listed in the Sample Containerization Procedures, Attachment B. Return each sample bottle to its proper transport container.
18. If the sample bottle cannot be filled quickly, keep them cool with their caps on until they are filled. The vials (3) labeled purgeable priority pollutant analysis should be filled from one bailer then securely capped. NOTE: Samples must not be allowed to freeze.
19. Record the physical appearance of the groundwater observed during sampling on the Groundwater Sampling Field Log.
20. After the last sample has been collected, record the date and time, and empty one bailer of water from the surface of the water in the well into the 200 ml beaker and measure and record the pH, and conductivity of the groundwater following the procedures outlined in the equipment operation manuals. Record this information on the Groundwater Sampling Field Log. The 200 ml breaker must then be rinsed with acetone and distilled water prior to reuse.

21. Begin the Chain of Custody Record, Attachment C. A separate form is required for each well with the required analysis listed individually.
22. Replace the well plug, and lock the well protection assembly before leaving the well location.
23. Place the polypropylene rope, gloves, rags, and plastic sheeting into a plastic bag for disposal.
24. Clean the bailer by rinsing with control water, acetone mixture, and finally distilled water. Store the clean bailer in a fresh plastic bag.

B. Sampling Procedures (PUMP)

1. Identify the well and record the location on the Groundwater Sampling Field Log.
2. Put on a new pair of disposable gloves.
3. Cut a slit in the center of the plastic sheet, and slip it over the well creating a clean surface onto which the sampling equipment can be positioned. This clean working area should be a minimum of 10 feet by 10 feet.
4. Clean all meters, tools, equipment, etc., before placing on the plastic sheet.
5. Disposable shoe covers should be placed over the samplers shoes to prevent potential contamination from dirty shoes contacting the plastic sheet. Do not kick, transfer, drop, or in any way let soils or other materials fall onto this plastic sheet unless it comes from inside the well.
6. Clean the well cap with a clean rag, and remove the well cap, and plug placing both on the plastic sheet.

7. Using a well depth probe measure the depth to the water table and the bottom of the well. Record this information on the Groundwater Sampling Field Log, Attachment A.
8. Clean the well probe with an acetone soaked towel and rinse it with distilled water after use.
9. Compute the volume of water in the well and record this volume on the Field Log.
10. Attach enough polypropylene rope to a bailer to reach just below the surface of the water table, and lower the bailer slowly into the well making certain to submerge it only far enough to fill it one-half full. The purpose of this procedure is to recover any film, if one is present on the water table.
11. Pull the bailer out of the well keeping the polypropylene rope on the plastic sheet. Empty the groundwater from the bailer into a new glass quart container and observe its appearance.  
NOTE: This sample will not undergo laboratory analysis and is collected to observe the physical appearance of the groundwater only.
12. Record the physical appearance of the groundwater on the Groundwater Sampling Field Log.
13. Prepare the submersible pump for operation.
14. Lower the pump to the bottom of the well and pump the groundwater into a graduated pail. Pumping should continue until three (3) well volumes have been removed or the well is pumped dry. If the well is pumped dry, allow sufficient time for the well to recover before proceeding. Record this information on the Groundwater Sampling Field Log.

15. Remove the sampling bottles from their transport containers, and prepare the bottles for receiving samples. Inspect all labels to insure proper sample identification. Sample bottles should be kept cool with their caps on until they are ready to receive samples. Arrange the sampling bottles to allow for convenient filling. Always fill the vials labeled purgeable priority pollutant first.
16. With the submersible pump raised to a level just below the surface of the water in the well, fill each sample container following the instructions listed in the Sample Containerization Procedures, Attachment B. Return each sampling bottle to its proper transport container. NOTE: While filling the sample vial labeled purgeable priority pollutant analysis, insure that the submersible pump intakes are located at a sufficient depth below the surface of the water to insure air is not introduced while filling the vials.
17. If the sample bottles cannot be filled completely, keep them cool with their caps on until they are filled. NOTE: Samples must not be allowed to freeze.
18. Record the physical appearance of the groundwater observed during sampling on the Groundwater Sampling Field Log.
19. After the last sample has been collected, record the date and time, and pump from the surface of the water in the well into the 200 ml beaker, filling it approximately halfway, then measure and record the pH, and conductivity of the groundwater following the procedures outlined in the equipment operation manuals. Record this information on the

Groundwater Sampling Field Log. The 200 ml beaker must then be rinsed with acetone and distilled water prior to reuse.

20. Begin the Chain of Custody Record, Attachment C. A separate form is required for each well with the required analysis listed individually.
21. Remove the submersible pump from the well and clean the pump and necessary tubing both internally and externally. Cleaning is comprised of rinses with source water, acetone mixture, and distilled water using disposable towels and separate wash basins. The pump should then be returned to its covered storage box.
22. Replace the well plug and lock the well protection assembly before leaving the well location.
23. Place the gloves, towels, disposable shoe covers and plastic sheet into a plastic bag for disposal.



GROUNDWATER SAMPLING FIELD LOG

Sample Location \_\_\_\_\_ Well No. \_\_\_\_\_

Sampled By \_\_\_\_\_ Date \_\_\_\_\_ Time \_\_\_\_\_

Weather \_\_\_\_\_ Sampled with Bailer \_\_\_\_\_ Pump \_\_\_\_\_

A. Water Table

Well depth (from top of standpipe) \_\_\_\_\_ Well elevation (top of standpipe) \_\_\_\_\_

Depth to water table (from top of standpipe) \_\_\_\_\_ Water table elevation \_\_\_\_\_

Length of water column (LWC) \_\_\_\_\_ (feet)

Volume of water in well - 2" diameter wells =  $0.163 \times (\text{LWC}) =$  \_\_\_\_\_ gallons  
- 4" diameter wells =  $0.653 \times (\text{LWC}) =$  \_\_\_\_\_ gallons  
- 6" diameter wells =  $1.469 \times (\text{LWC}) =$  \_\_\_\_\_ gallons

B. Physical Appearance At Start

Color \_\_\_\_\_ Odor \_\_\_\_\_ Turbidity \_\_\_\_\_

Was an oil film or layer apparent? \_\_\_\_\_

C. Preparation of Well for Sampling

Amount of water removed before sampling \_\_\_\_\_ gallons

Did well go dry? \_\_\_\_\_

D. Physical Appearance During Sampling

Color \_\_\_\_\_ Odor \_\_\_\_\_ Turbidity \_\_\_\_\_

Was an oil film or layer apparent? \_\_\_\_\_

E. Well Sampling

<u>Analysis</u>	<u>Bottle No.</u>	<u>Special Sampling Instructions</u>
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

F. Conductivity \_\_\_\_\_ pH \_\_\_\_\_

SAMPLE CONTAINERIZATION PROCEDURES

<u>Analysis</u>	<u>Container Description</u>	<u>Number of Containers</u>	<u>Collection Instructions</u>
Purgeable Priority Pollutants	40 ml vial	3	<ol style="list-style-type: none"> <li>1. The sample vial consists of 3 parts: a glass bottle, a teflon-faced septum, and a screw cap.</li> <li>2. Remove the cap and septum, handling the septum by the edges only.</li> <li>3. Carefully fill the vial to overflowing a slight crown of water remaining on top.</li> <li>4. Slide the septum, teflon-side (slippery side) down, onto the vial.</li> <li>5. Replace the cap and tighten.</li> <li>6. Invert the sample and lightly tap the cap on a solid surface. The absence of trapped air indicates a successful seal. If bubbles are present, open the bottle, add a few additional drops of sample and reseal the bottle as above. Continue until no entrapped air is present.</li> </ol>
PCBs, Pesticides	glass quarts	2	Fill one quart jar, apply aluminum foil liner, then cap.
Metals	pint plastic container	1	Fill pint bottle then cap.
Acid/Base Neutral Priority Pollutants	glass quarts	2	Fill one quart jar, apply aluminum foil liner, then cap.
Cyanide	glass quart w/ preservative added	1	Fill (do not overfill) quart jar then cap.
Phenols	glass quart w/ preservative added	1	Fill (do not overfill) quart jar then cap.
TOC	60 ml plastic vial w/preservative added.	1	Fill (do not overfill) vial then cap.
TDS	1 pint plastic bottle	1	Fill quart then cap.

NOTE: All samples are refrigerated or placed on ice, but not allowed to freeze.



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DISPOSAL AREA SOIL SAMPLING PROTOCOL

Soil Sampling Procedures

Split spoon soil samples will be collected from the proposed test borings continuously from the surface to the bottom of the predefined disposal area (estimated 25').

The sampling method employed shall be ASTM D-1586/Split Barrel Sampling. Soil samples will be retrieved using (2.5') x 3" O.D. split spoons. Physical appearance will be described on site by an O'Brien & Gere geologist and odors will be noted. Composite samples of each spoon will be retained in one (1) pint glass jar with teflon tops or aluminum foil-lined tops. In addition, for each sample a 1/4 pint glass jar will be filled halfway with soil for chemical analysis in the field.

After each soil sample is brought to the surface and jarred, the split spoon will be cleaned with tapwater rinse, Nanograde methanol swabbing and a controlled-source water rinse. In addition, the sampler's gloves and any tools and surfaces in contact with any soil sample will be cleaned with methanol and water or discarded and replaced with clean materials.

All jars containing soil samples will be immediately labeled with boring number, date and interval sampled and stored on-site in a cooler on ice. Upon completion of a sampling day, all soil samples will be sent in the same coolers on ice to the O'Brien & Gere laboratory. Laboratory personnel will receive the soil samples, label them for laboratory use and transfer the jars to a refrigerator until analysis begins.

To insure the integrity of the soil samples, a chain of custody will be initiated at the time of shipping and ended upon arrival in the O'Brien

& Gere Laboratory. Samples will be stored in an area restricted to O'Brien & Gere personnel.

A field survey control program will be conducted using standard instrument survey technicians to document the sampling locations and elevations.

#### Field Analytical Procedures

Upon opening of each split spoon, air near the spoon will be monitored with an HNU meter. The concentration will be recorded when the meter stabilizes.

After approximately five minutes on ice at 0°C, the additional 1/4 pint sample jar filled with 1/8 pint of soil will be removed from the cooler. With the top removed, the aluminum foil or teflon will be punctured 1/4" to allow instrument access without excessive loss of air from the jar. The HNU probe will then be placed in a jar and concentrations recorded of the initial readings.

The supervising geologist/engineer will determine which soil samples will require Draeger tube readings. If a Draeger tube reading is necessary, the Draeger tube will be added to the 1/4 pint jar through the foil/teflon slit and run in accordance with Draeger tube operating instructions 234-28541, 1st edition, February, 1978. The concentration will be recorded and the jar will be retained for further testing at the O'Brien & Gere laboratory.

#### Equipment Decontamination

All drilling equipment and associated tools including rods, sampling equipment, mud tanks, and tools that may have come in contact with contaminated materials shall be decontaminated using a controlled water source scrub to remove any residual soil, followed by a Nongrade acetone swabbing and a distilled water rinse.

Decontamination shall be executed upon completion at each boring location and prior to the equipment leaving the site.

IN-SITU PERMEABILITY TEST  
PROTOCOL

Objective

To determine the permeability of a predetermined subsurface soil layer.

METHODOLOGY AND PROCEDURES

- A. All water used will be from a controlled source.
- B. Water levels will be measured prior to start of test.
- C. In the event that the soil to be tested is unsaturated, the piezometer will be filled with water and allowed to stand for a minimum of 72 hours to allow complete saturation of the gravel pack and surrounding material.
- D. The piezometer shall be filled to within 2 feet of the top of the casing.
- E. The zero minute or start time will be at the time of the first water level measurement, after the piezometer is filled.
- F. Water level shall be measured every minute for the first 5 minutes, every two minutes until 12 minutes have elapsed and continuing at preset intervals of 3, 4, 5, 10, 15 and 20 minutes until a total of 120 minutes (2 hour) has elapsed.

DATA REDUCTION AND ANALYSIS

- A. The method used in the analysis of the test data is based on Hvorslev's Method for a point piezometer.
- B. The head measurement (h) will be the distance from the measured water level to the top of the sand pack of the well being tested and is to be calculated for each time interval.
- C. The change in head ( $\Delta h$ ) is the different between the head at time zero and the head each time thereafter.

- D. Time after start of test vs. change in head will be plotted on semi-log paper.
- E. The data is analyzed using a hand-held computer program by Weyer & Horwood-Brown applying Hvorslev's Formulae (Groundwater Vol. 20, No. 3, May-June 1982 P. 289).



## Appendix B-7

### STREAM SEDIMENT SAMPLING PROTOCOL

#### Establishment of Sediment Sampling Stations

1. Establish sampling stations by setting stakes on opposite banks of the brook at the up stream off-site, on-site, and downstream off site locations.
2. In accordance with the topographic survey and visual confirmation in the field, the exact location of each sediment core along the cross-section will be defined and flagged on the line stretching across the brook.
3. The number of sediment cores at each station will be established according to the following criteria:
  - a. For cross-section of less than or equal to 6.0 feet: Establish three (3) equidistant coring locations across the expanse of the brook at the section midpoint and midpoints of the resulting halves.
  - b. For cross-section of greater than 6.0 feet: Equidistant coring locations shall be established at the section midpoint and across the expanse of the brook such that no two adjacent cores will be separated by a distance greater than 18 inches.
4. At each established sampling station, traverse the brook from bank to bank with a wooden bridge so as to minimize disturbance of the sediment layer upon sampling.
5. Establish the elevations of sediments and water level at each station at the time of sediment sampling.

#### Cores and Core Sampling Criteria

Approach: Core sampling is a reliable method for obtaining basic data for investigations of sediments underlying a water body. A Wilco Bottom Corer (Wildlife Supply Company, Saginow, Michigan), Model No. 2424-A55 will be used in this study to obtain 2-inch diameter cylindrical sections of the sediments. This instrument consists of a 48" stainless steel core tube and head assembly which is used to drive a section of Lexan (polycarbonate) tubing into the sediment to obtain a representative sample profile. This sampling protocol has been devised for obtaining cores of layered sediments, with minimum disturbance of the layers by compression and/or displacement around the circumference.

All sampling personnel will be equipped with water-proof outer garments. Disposable gloves will be used and changed prior to the undertaking of each core sample.

1. Core Sampler Preparation:

- a. Clean the stainless steel core tube and head assembly with detergent and rinse in tap water and an appropriate solvent (hexane or acetone) prior to each use.
- b. Insert a new Lexan tube liner into the stainless steel core tube and screw down the head assembly.

2. Perpendicular placement: Utilizing a wooden bridge (spanning the brook) as a working platform, inset the core sampling at the marked point designations (see Establishment of Sediment Sampling Stations, No.2) with a straight, vertical entry into the sediments so as to secure a reliably representative cross-section sample.

3. Penetration: Push the sampler, in a smooth and continuous movement, through the water and into the sediments, increasing the thrust as necessary to obtain the penetration desired.

4. Lift the stainless steel core tube and head assembly clear of the water, wrapping the bottom of the 48" core tube in cloth so as to avoid dripping stream water into the in-place Lexan tube liner which remains in the sediments undisturbed.

5. Measure the sediment layer distance from the top of the Lexan tube liner.

6. Secure a hand pump (Jabsco Products ITT No.33799-0000) onto the exposed Lexan tube liner opening and fasten with a rubberized stopper.

7. Pump to create a sufficient vacuum within the liner to prevent loss of sampling upon removing the Lexan tube from the sediments. Note: Experimental determinations conducted by O'Brien & Gere personnel has revealed five (5) hand pumps to full arm extension provide sufficient vacuum without displacing the collected sediment core within the tube liner.

8. Lift the Lexan tube liner, clear of the sediment layer and cap the bottom of the tube using clean gloves (second sampling crew member) with a 2-inch polyethylene cap before breaking the streamwater surface keeping the liner vertical throughout the withdrawal process.

9. Wipe down the Lexan tube liner with a dry rag to increase visibility through the clear tubing for in-situ observation and documentation.

10. Remeasure the sediment layer to verify that displacement did not occur due to the imposition of negative (vacuum) pressure.

11. Acceptance of the cores as representative samples of the existing sediment bed will be at the discretion of the Field Engineer.

12. All observations during sampling and in-situ sediment core description shall be noted and documented by the Field Engineer; all cores shall be numbered, photographed and logged accordingly.

13. Clean the Lexan tube liner with a detergent wash and rinse with tap water and an appropriate solvent to avoid contamination.
14. Place the cleaned Lexan tube liner in a secure rack holder for transport to the field office.
15. All type liners containing sediment sampling will be stored in a freezer unit located in the field office for the purpose of obtaining sediment layer sections.
16. Discard gloves and rags in a designated 55-gallon drum after each sampling core has been obtained, clean the stainless steel sampler as specified in Item 1 and repeat the above outlined procedure for each designated core (i.e. a minimum of three (3) for each stream sampling station).
17. At the conclusion of the day's sampling all tools and instruments are to be cleaned, and outer clothing secured for reuse the next day; all outer clothing should be removed only when wearing disposable gloves. Upon conclusion of the project all outer garments will be placed in a 55-gallon drum and disposed of properly.

#### SAMPLE PREPARATION PROTOCOL

1. Locate in freezer all cores from one sampling station and note each core designation in sample preparation diary. Review any notes or pictures taken while these cores were obtained in the field as presented in field sampling diary.
2. Prepare the same number of sample segmenting areas as cores from specific sampling station. Segmenting areas shall be prepared by spreading fresh paper, water-acetone-hexane washing 12 metal spatulas and placing 5 sample jars in area.
3. Prepare the same number of cutting areas as cores from specific sampling station. Cutting area shall be prepared by placing fresh paper on table and having available a circular saw blade and jig that have been water-acetone-hexane washed.
4. Wearing fresh pair of disposable glove, remove one of the designated cores from freezer and place on cutting area. Using circular saw and jig, laterally cut lexan tubing on both sides of core. Cut should extend to the depth of lexan tube and not into frozen sediment core. Place core on prepared segmenting area. Repeat this procedure until all the cores from one sampling station have been cut and placed in separate segmenting areas.
5. After core has thawed to where it is the consistency of hard butter (1-2 hours), wearing a fresh pair of disposable gloves, remove the lexan tubing from the core by prying away tube with spatula and dispose of spatula. Repeat this procedure for all cores from one sampling station.

6. Once all the cores of one specific sampling station are exposed, a determination of sediment layers will be made. This determination, based on sampling documentation of sediment layers will be made. This determination, based on sampling documentation and visual observation, will identify the extent of similar sediments within the cores. Once this identification is made, a physical description noting grain size, color, odor, etc. plus the length of sediment layer should be entered into the sample preparation diary. These cores may be spilt using a spatula to aid in making this determination. The spatula should be changed at each apparent interface to avoid contaminant transfer.
7. A quart jar shall be labeled with samplings station designation and sediment layer location (i.e. top, middle, bottom) for each sediment layer identified. Like sediments from each of the cores should be separated from the core and placed in the proper quart jar. To avoid any cross contamination between sediment layers within the same core, samples should not be taken at or near the interface of difference sediment layers. When taking samples, a clean spatula should be used for each individual sample of sediment.
8. Once all like sediments from all cores are placed in the proper jar, the sample within the jar should be composited by mixing with a clean spatula for approximately five minutes. This should be repeated for each sediment layer identified.
9. Approximately 100 grams of the composited sample should be taken from the quart jar and transferred into a properly labeled half pint jar. All jars shall be sealed using aluminium foil and the jar top.
10. The half pint jar should be transported to the Syracuse laboratory for analysis and the quart jar should be archived for future use.
11. All wastes resulting from this sample preparation, including any remaining sediment, shall be disposed of in the 55 gallon drum located within the sample preparation room and marked for this purpose.

# **Quality Assurance/ Quality Control Protocols**



**O'BRIEN & GERE**

## LABORATORY CAPABILITIES

### Introduction

O'Brien & Gere has been involved in the analysis of environmental contaminants for a wide range of federal, state, municipal and industrial clients. For several years, the laboratory has analyzed over 10,000 samples for over 100,000 parameters on an annual basis.

The laboratory is located in the corporate headquarters of O'Brien & Gere in Syracuse, NY and maintains a staff of over 20 chemists, biologists and technicians. As many as ten temporary and part-time personnel have been used to meet peak demands. The laboratory has 3700 square feet to utilize for the preparation and analysis of samples and 1200 square feet for receiving and storage of reagents. Addition of a 640-square foot sample preparation room in 1983 has enabled the laboratory to continue to provide clients with state-of-the-art analyses of dioxin.

### Experience

The laboratory's involvement in a variety of programs has provided the necessary experience in microbiological, inorganic contaminants and trace organic identification and quantitation. Particular expertise has been developed in the area of hazardous waste identification and trace organics analysis including priority pollutants, PCBs, dioxins and dibenzofurans. Recent projects have included:

- (a) National Law Firm (confidential) - Investigation and evaluation of three industrial/municipal landfill and dump sites which have received PCBs. Full chain of custody procedures employed because samples were out of state. Necessary documentation for litigation was prepared.
- (b) Electronics Manufacturer (confidential) - Collect and analyze soil, water, groundwater and contaminated building material for PCBs. Program required litigation, therefore chain of custody protocol and QA/QC were maintained throughout program.
- (c) New York State Department of Environmental Conservation - Immediate response to a hazardous waste site for identification of organic contaminants which pose hazard to immediate public.
- (d) Iron and Steel Manufacturer - Groundwater monitoring program for a hazardous waste disposal site. Chain of custody protocol followed.
- (e) Pharmaceutical Manufacturer - Immediate response to a hazardous waste spill. Included identification of the extent of spill and ultimate notification under the Comprehensive Environmental Response, Compensation and Liability Act.
- (f) Oil Reclaimer - Subsurface tank leakage - Analyze air sample in area residence to identify extent and nature of contaminant.

- (g) Organic Chemical Manufacturer - Characterization of lagoon cores for appropriate disposal alternatives. Analyses included base neutral identification and toxicity extraction for possible hazardous waste classification.
- (h) Electronics Manufacturer - Characterize stream sediments for the extent of PCB and volatile organic contamination. Several hundred samples throughout the reach of the stream and at varying depths were analyzed.
- (i) Metal Fabricator - A groundwater monitoring program to identify the plume of volatile halogenated organics.
- (j) New York State Department of Environmental Conservation - Gas chromatographic analysis of over 3000 samples of Hudson River waters, sediments, fish and other biological samples for PCBs.
- (k) New York State Department of Environmental Conservation - Hudson River water treatability study at Waterford, N.Y., with emphasis on the removal of low-level organic compounds, including PCBs.
- (l) Automobile Manufacturer - Analysis of over 250 hydraulic fluid resources for PCBs.
- (m) U.S. Army Corps of Engineers - Analysis of Maine lobster (Homarus americanus) for the bioaccumulation of PCBs, DDT, mercury, cadmium and petroleum hydrocarbons.
- (n) Paper Manufacturer - Analysis of Mirex and PCBs in water, sediments and fish.
- (o) Electronics Manufacturer - Analysis of a variety of environmental samples including water, oil, air sediment and sludge for priority pollutants.
- (p) Metropolitan Water Board, Onondaga County, New York - Analysis of Lake Ontario water supply for PCBs and pesticides.
- (q) Niagara Mohawk Power Corporation, Syracuse, New York - Analysis of samples of waste transformer oil for PCB content.
- (r) Analyze influents, effluent and sludge sample for priority pollutants. Results were used to develop contaminant mass balance throughout treatment plant processes. Analysis required under pretreatment regulations for the following clients:
  - 1) Westchester County, NY
  - 2) City of Jamestown, NY
  - 3) City of Schenectady, NY
  - 4) Howard County, MD
  - 5) Kent County, DE
  - 6) City of Poughkeepsie, NY
- (s) Paper Manufacturer - Analysis of paper products for PCB content.

- (t) Electronics Manufacturer - Analysis of groundwaters for volatile halogenated and aromatic hydrocarbons.
- (u) U.S. Environmental Protection Agency - Analysis and evaluation of mutagenic potential of wastewater through the Ames bioassay.
- (v) Corps of Engineers, Fort Drum, Watertown, N.Y. - Analysis of groundwater for chlorinated hydrocarbons including PCBs.
- (w) Onondaga County, N.Y. - Industrial-municipal effluents for priority pollutants.
- (x) Southwest Research Institute, San Antonio, Texas - EPA methods validation study for phthalate acid esters.
- (y) Monsanto Research Institute, Dayton, Ohio - EPA methods validation study for volatile hydrocarbons.
- (z) Conventional pollutant analysis including nutrient, heavy metals and other wet chemical techniques have been performed on combined sewer overflow programs for the following clients:
  - (1) Onondaga County, NY Department of Drainage & Sanitation
  - (2) Monroe County, NY Division of Pure Waters
  - (3) Metropolitan District Commission, Boston, MA
  - (4) Washington, D.C.
  - (5) City of Poughkeepsie, N.Y.
  - (6) City of Utica, N.Y.

#### Certification

The U.S. Environmental Protection Agency certifies state laboratories to conduct their own intrastate program of certification for the proficiency of private laboratories in potable water analysis. The EPA only certifies private laboratories directly in those states which have not been approved to establish their own programs. In New York State, the certifying agency is the NYS Department of Health. The Firm's laboratory was one of the first participants in the New York State program and has been certified for chemical, atomic absorption, bacteriological and gas chromatographic analysis of water since 1974. Laboratory certification has been extended to the states of Massachusetts, Pennsylvania and New Jersey.

Additionally, the laboratory participates in the round robin analyses of reference samples supplied by the EPA and in the analysis of commercially available reference samples. The laboratory has provided analytical services in projects supported by EPA.

#### Laboratory Instrumentation

The following instrumentation is located in the Syracuse office and has been used on a number of major analytical programs.

- (a) Hewlett Packard 5993B Gas Chromatograph/Mass Spectrometer/Data System - for the low level identification of organic priority



pollutants and other compounds. The unit is equipped with a dual disc, 32K computer and 9-track magnetic tape.

- (b) Hewlett Packard 5790/5970A Gas Chromatograph equipped with a mass selective detector. The unit has the capability of selected ion monitoring (SIM) for six ions and is totally dedicated to dioxin analyses.
- (c) Hewlett Packard 5880A Gas Chromatograph equipped with dual electron capture detectors. The fully automated system has capabilities for both packed and capillary column work. The system can operate unattended around the clock to provide rapid turnaround of results.
- (d) Tracor Model 565 Gas Chromatograph equipped with a Hall electrolyte detector and photoionization detector. A Tekmar 10 port purge and trap system is interfaced to allow for around the clock analysis of purgeable aliphatic and aromatic hydrocarbons.
- (e) Tracor Model MT220 Gas Chromatograph equipped with electron capture and dual flame ionization. The unit is interfaced to a Hewlett Packard Model 3380S integrator.
- (f) 2 Tracor Model 550 Gas Chromatographs, both equipped with Hall electrolytic conductivity detectors, linearized electron capture detectors, and photoionization detectors interfaced to Hewlett Packard Model 3380S integrators.
- (g) Xertex/Dohrmann Total Organic Halogen Analyzer - A microcoulometric titration analyzer designed to quantitatively determine organic or inorganic bound halogen or sulfur in solids, liquids and gases.
- (h) Varian Model 575 Atomic Absorption Spectrophotometer for the low-level detection of metals by conventional flame and graphite furnace (flameless) techniques.
- (i) Perkin-Elmer Model 290B Atomic Absorption Spectrophotometer for the determination of metals by flame techniques.
- (j) Beckman Model 915 Total Organic Carbon Analyzer, for the determination of organic, inorganic or total carbon.
- (k) 2 Technicon AutoAnalyzers, single and dual channel, for the automated determination of nutrients and other inorganic parameters.
- (l) Bausch & Lomb Model 340 colorimeter, used for those colorimetric procedures not performed on the AutoAnalyzers.
- (m) DuPont Model 760 Luminescence Biometer for the determination of adenosine triphosphate (ATP).
- (n) Orion Model 4 Specific Ion Meter
- (o) Mettler Model HE10 Electronic Semi-Micro Balance

(p) Hiack Particle Counter for the determination of particle sizes in water ranging from 0.5 to 300 microns.

(q) Due to the highly specialized procedures for cleaning glassware used in the low level analysis of halogenated organics and other substances, a sonic cleaner is utilized. Additionally, a complete glassware supply including Soxhlet extractors, separatory funnels, flasks and chromatographic columns is maintained.

(r) A walk-in, cooler at 4°C to properly store all samples received.

The laboratory also maintains a wide range of the usual supporting equipment such as pH meters, analytical balances, ovens and incubators, refrigerators and hood space.

#### Mutagenicity Testing - Ames Salmonella Bioassay

In order to evaluate the biological hazard potential posed by a substance, O'Brien & Gere can provide analysis by the Ames Salmonella/microsome mutagenicity test. Capabilities include the following specific tests:

- determination of mutagenic potential without rat liver activation
- determination of mutagenic potential with rat liver activation
- dose/response curves for a substance
- comparison of hazardous potential with known mutagens and carcinogens
- detailed analytical reports

This test which was developed by biochemists Bruce N. Ames and co-workers at the University of California at Berkley in the early 1970s relies on the tendency of some previously mutated bacterial cells to undergo a subsequent mutation back to their natural state when exposed to certain mutagenic chemicals. This very sensitive and simple test offers distinct advantages of speed, ease and relatively low cost when compared to classical whole animal study techniques. The test can be used to evaluate the mutagenic or carcinogenic potential of mixed, or undefined, solutions and pure compounds. Applications where it has been used include:

Wastewater  
  sanitary  
  industrial  
  combined sewer overflows  
Air Emissions and Pollutants  
Crankcase Oils  
Drinking Water  
Algal By-Products  
Animal Feed Additives  
Cosmetics  
  hair dyes

Treatment Plant Effluents  
  industrial  
  municipal  
Pesticides and Herbicides  
Drugs  
Surface Waters: Lakes, Rivers  
Rain Water  
Plant Extracts  
Foods and Food Extracts  
  milk  
  saccharin  
  coffee  
  cooked beef

### Sample Storage and Receiving

Since samples may be delivered outside normal business hours, it is important to note that O'Brien & Gere maintains a sample receiving room complete with refrigerated storage facilities allowing for delivery on a 24-hour basis. The laboratory routinely holds all sample extracts for three years. Facilities for the storage of over 1000 samples are available.

### Transportation

The Syracuse office is ideally suited for the rapid long-distance transport of samples. Two interstate highways, U.S. 90 and 81, intersect within one mile of the office. The area is served by two major bus lines, Greyhound and Trailways, through a major station in the urban area. Syracuse Hancock International Airport is serviced by several airlines, including American, Eastern, US Air and Empire, which have many daily flights to and from most of the country. Additionally, there is a large amount of commercial and charter air traffic at the airport. Syracuse has long been a major station in the eastern railway network and is currently served by Amtrak. As a last method of sample delivery, the firm has employed several courier services which guarantee 24-hour delivery from any point within the contiguous United States.

### Computer Services

The hardware which serves as the foundation of the Firm's computer facilities has been responsible for the ability of the O'Brien & Gere laboratory to undertake many, if not most, of the projects in which it has been involved.

The annual average basis over the past several years has been 10,000 samples received and over 100,000 analyses performed. This quantity of data has led to the development and utilization of a computer-based data management system. Samples are logged in, analyses are scheduled and output is received, all via time-shared or batch computer programs. One of the benefits of this system is that turnaround time has been reduced to a practical minimum. Data can be reported in a variety of formats. The standard computer output includes sample identification and various test results. A variety of statistical and modeling programs are available for the evaluation and interpretation of data. In-house programming services are available for the design and preparation of job-specific programs tailored to individual project problems.

O'Brien & Gere's computer facilities include a Xerox 560 system located in the Syracuse office. This system consists of a Xerox 560 central processing unit with an 96K, 32 bit word core capacity, and auxiliary storage available through two Xerox model 3275 disk drives each having 200 MG capacity. Card input is read by a Xerox 7122 card reader at the rate of 400 cards per minute. A Houston Instruments Model DP-7 plotter has also been incorporated into the 560 system for high resolution output. Additional input-output devices include several terminals of varying types located throughout the Syracuse office and the branch offices.

## CHAIN OF CUSTODY

A critical concern in any project, especially those where a large number of samples and analysis of multiple parameters is required, is the maintenance of sample and data base integrity and the timely preparation of data reports. Any sample is physical evidence of a current situation in the environment. Therefore, an essential part of all evaluations and/or enforcement is the proper tracking of the sample from collection to submission of results. To maintain and document sample possession, chain-of-custody procedures are followed.

### Field Custody Procedures

1. Collect only that number which provides a good representation of the media being sampled. As few people as possible should handle samples.
2. The field sampler is personally responsible for the care and custody of the samples collected until they are transferred or dispatched properly.
3. The Project Coordinator determines whether proper custody procedures were followed during the field work and decides if additional samples are required.

### Transfer of Custody and Shipment

1. Samples are accompanied by a Chain-of-Custody Record (following page). When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the analyst, in a mobile laboratory, or at the laboratory.
2. Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis. The method of shipment, courier name(s) and other pertinent information are entered on the bottom of form.
3. All shipments will be accompanied by the Chain-of-Custody Record identifying its contents. The original record will accompany the shipment, and a copy will be retained by the Project Coordinator.
4. If sent by mail, the package will be registered with return receipt requested. Freight bills, Post Office receipts, and Bills of Lading will be retained as part of the permanent documentation.

### CHAIN OF CUSTODY RECORD

[illegible]

## DATA MANAGEMENT

O'Brien & Gere has faced the difficulties of sample integrity and data management in previous investigations and in the routine operation of its laboratory. An extensive program has been developed, in conjunction with the firm's own computer system, for the identification of samples and the maintenance of the discrete character of the data generated by each respective sample. This program combines:

- (a) The hardware of the computer system and
- (b) The laboratory's computer-based data management system

It is anticipated that this data management system will be utilized to expedite sample turnover time, improve the general organization and facilitate data handling and storage for the project. This system is a unique advantage over manual methods and has permitted the laboratory to successfully complete projects involving high numbers of samples and multiple analyses. The system may be divided into the following phases:

Sample Identification - as each sample enters the laboratory it is assigned a unique access number found on a sample identification ticket. This ticket permits the storage of discrete sampling information. Once all the pertinent information is recorded on the ticket, the tissue copy is forwarded to computer for storage and the hard copy is affixed to the sample container. At this point the analyst refers to that sample by number and not client. Therefore, its confidentiality is maintained. This number is used for scheduling the analyses and reporting analytical results. Upon completion of the analysis, the sample number is removed from the schedule queue so the analyst does not duplicate the analysis. All sampling data and results are stored in the computer files for ten years.

Data Organization - in a preliminary planning phase of any analytical investigation involving the laboratory, a computer codification format can be established which can serve as the basis for data storage and recovery. This format is characterized by the categorization of samples, with any type of identification permissible for the classification. The categories may be based on any similarities (or dissimilarities) in the total volume of samples. There are four ID fields for identifying a specific sample. As an example, if a series of hourly grab samples were collected from several manholes along a trunk line, then each field could be assigned a primary location, secondary location, number of grab sample and time. Then the data for each sample has a specific location and is stored under numeric identifiers.

Upon completion of the analytical scheme, using the numeric identifier, we have the ability to present a data printout to the client specifically sorted for their needs. In addition, the data can be presented in a graphical presentation and statistical techniques performed on the data. Accuracy and precision data is generated daily and stored in the system for submittal with analytical results.

Appropriate field sheets must be completed at the time of sample collection. In addition, a bound field notebook must be maintained by the survey leader to provide a daily record of significant events. All entries must be signed and dated. All members of the survey party must use this notebook. Keep the notebook as a permanent record. In a legal proceeding, notes, if referred to, are subject to crossexamination and admissible as evidence.

Upon receipt in laboratory, custody will be transferred by the signature of a staff member recording date and time. This document becomes a permanent record and is filed with the data report form. The lab staff will then assign each sample a unique number for data storage and retrieval purposes.

## QUALITY CONTROL

O'Brien & Gere is committed to rigorous quality control for all analyses performed in its environmental laboratory, and maintains high technical standards in its identification of microbiological, inorganic, or organic contaminants. The laboratory's primary objective is to ensure precision and accuracy in all the data it generates. It is these efforts which are monitored by the quality assurance/quality control (QA/QC) program. The goal of this program is to produce a quality control program which is sensitive to the needs of the clients, which will allow accurate decision-making, and which permits continuous refinement of analytical procedures.

O'Brien & Gere's program has evolved to its present level as a result of regulatory requirements, including certification of the laboratory as required by the U.S. Environmental Protection Agency. It has also matured because of the increased technical sophistication required of environmental analyses.

The quality control program proceeds in step with the chain of custody. Each step of the process is recorded carefully, and all records are maintained in laboratory files for five years. The Firm has committed a full time chemist to monitoring the daily operations of its QA/QC program. The program's results are placed in the computer; giving a real-time analysis of the QA/QC data. The laboratory staff devotes, on the average, one eighth of their time to QA/QC effort. Efforts for excellence in the laboratory go beyond the extensive program of QA/QC analyses and extend into monitoring the conditions of instruments, calibrations, preparations of reagents, and the corrective measures incorporated.

### QA/QC Program Results

This significant effort has one goal; excellence in laboratory analysis. A client knows that he will receive scientifically valid and reliable results. In addition, he is assured that all data reported are of known and documented quality commensurate with their intended use. Most important to the client is the fact that the laboratory is able to guarantee and to document defined levels of certainty in the analyses. With this program, the client is guaranteed, with 99 percent confidence, that the results of the analysis will be within acceptable limits. O'Brien & Gere delivers results that are precise and valid.

### Inter- and Intralaboratory Programs

The laboratory participates in interlaboratory programs through the certification programs of various States. Intralaboratory programs include the analysis of duplicates, spikes, surrogate spikes, and reference samples.

In quality control, precision means the agreement within a set of replicate results. Precision is described in terms of deviation, variance, or range. The term accuracy refers to the nearness of the analytical result to the true value. It is described in terms of error, bias, or percent recovery. Together with the samples analyzed in the laboratory, the staff uses duplicate samples, spiked samples, blanks, and samples with a predetermined



concentration of the parameter called the "reference standard" to judge precision and accuracy.

A "spiked sample" is one which has a specific amount of the parameter added to a sample already analyzed. The accuracy of an analytical method is determined by the recovery of the analyte from the sample matrix. Following analysis of the spiked sample, the technician records the total amount of the parameter. The concentration of the parameter that are found in the spiked sample is used to calculate recoveries which are compared to the control limits in the data base. Analyses found within the control limits are accepted as valid. If the value is found to be beyond these limits, the analysis will be rejected, and the sample will be re-analyzed.

A sample can be split, and multiple analyses can be performed. These are "duplicate samples," and they indicate the precision of the analytical method: the ability to reproduce a result while performing any given procedure.

Many samples are analyzed in the presence of reagents. A "blank" sample is simply distilled water into which the reagents have been added. In analyzing a blank, no amount of the parameter should be present. If the parameter is measured, the analyses is deemed contaminated. Whenever contamination is found through the analysis of blanks, the laboratory searches for its source. Any contamination which is found is recorded, and those records are used to correct analytical values or, if necessary, to reject a set of analyses.

### Error Detection

There are two categories of error which may occur in analytical programs: systematic and random. Systematic errors are caused by an incorrect or faulty procedure; these errors produce inaccurate results. With the rigorous quality assurance/quality control program, these errors are detected, and the analyst is able to make the necessary corrections.

There can be many causes of random errors, and they may relate to the skill of the analyst. Random errors affect precision more than they affect accuracy, and they are difficult to correct. The quality control program can assess the magnitude of error, and it can assign a level of confidence to the data. A low level of confidence indicates a need for additional training for the analyst.

### Data Management

The data gathered in the laboratory's QA/QC program result in a mass of records. The laboratory employs sophisticated methods to order and analyze the data, and this system ensures that the handling of samples is documented at every step. The day-to-day efforts of the quality assurance/quality control program build a "QA/QC Model." This model provides detailed control charts and control limits which measure the performance of the laboratory daily. Examples of control charts are listed in Figures 1 and 2; the daily quality control efforts to ascertain quality assurance are summarized in Figure 3.

The data management system begins to track a sample as it enters the laboratory. Each sample is tagged with a unique identification number. A computer-managed coding format is used to categorize samples; this format can be adapted to every analytical investigation, and it then serves as the basis for storage and retrieval of data.

Any measurement which is made repeatedly will display a number of slightly different results. Because not all the measurements can be the same, they will be distributed, typically close to the mean or average. The overall distribution will be that of the normal curve with the familiar bell shape. The QA/QC program monitors the mean and standard deviation from the mean. Control limits are calculated at  $\pm 3$  standard deviations from the mean (99.9% confidence level of the normal distribution).

As quality control data are collected, the exact distribution of the data is determined. Statistical methods evaluate the quality of the data by calculating control limits and warning limits for each parameter by matrix. See Figures 1 and 2. The warning limit is defined as  $\pm 2$  standard deviations on either side of the mean; this provides a 95% confidence level. The control limit refers to an interval of  $\pm 3$  standard deviations on either side of the mean and provides a confidence level of 99.9%.

An analyst in the environmental laboratory may examine the quality control data base at any time. He may check the percent recovery, duplicate ratios, percent of reference standard, and a blank value against the most recent mean, standard deviation, and control limits which have been calculated for each data base. Thus, the analyst can determine whether or not the values he found are within an acceptable range.

### Daily Record

On a daily basis, the quality assurance/quality control program manages data which monitors all laboratory analyses of duplicate and spiked samples and synthetic knowns. The leader of the QA/QC Group reviews the statistical programs which monitor these analyses daily. He checks the most recent data base in the computer. Therefore, he can know immediately whether or not the analytical method's performance is within acceptable ranges, and he can decide whether to accept, reject, or repeat the analyses.

Each day the QA/QC group leader is able to review a computer printout of information on the quality control samples. The sample number, test parameter, QC sample type, data of analysis, percent recoveries, relative errors, and warning and control limits are shown on this printout. The QA/QC leader is thus able to examine these data each day and determine acceptability. A scan of the sheet can tell him the status of unfinished samples and the values of quality control data entering data bases.

FIGURE 1  
ESSENTIALS OF CONTROL CHARTS

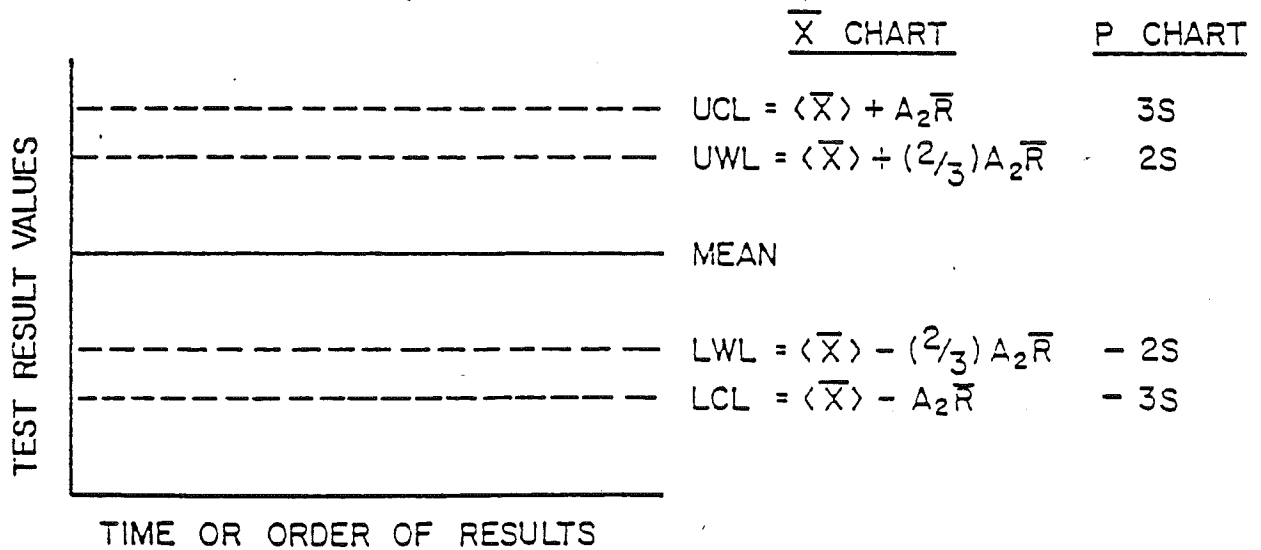
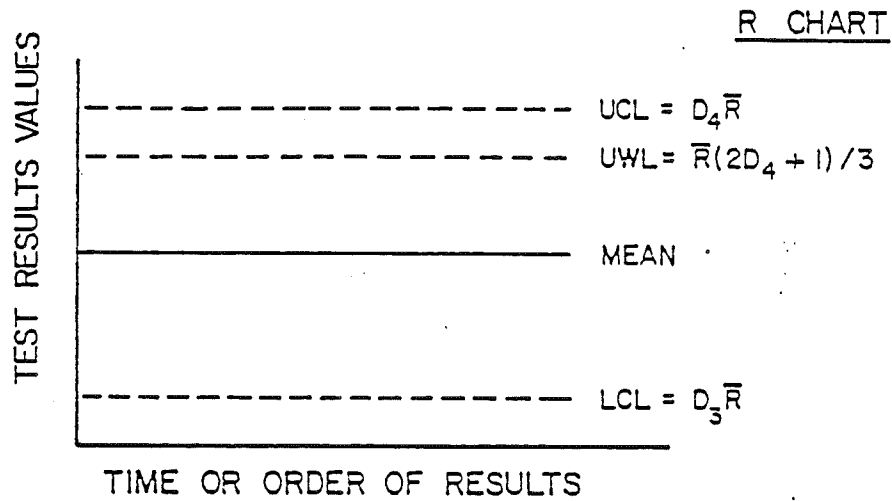


FIGURE 2  
SPIKED RECOVERY CONTROL CHART

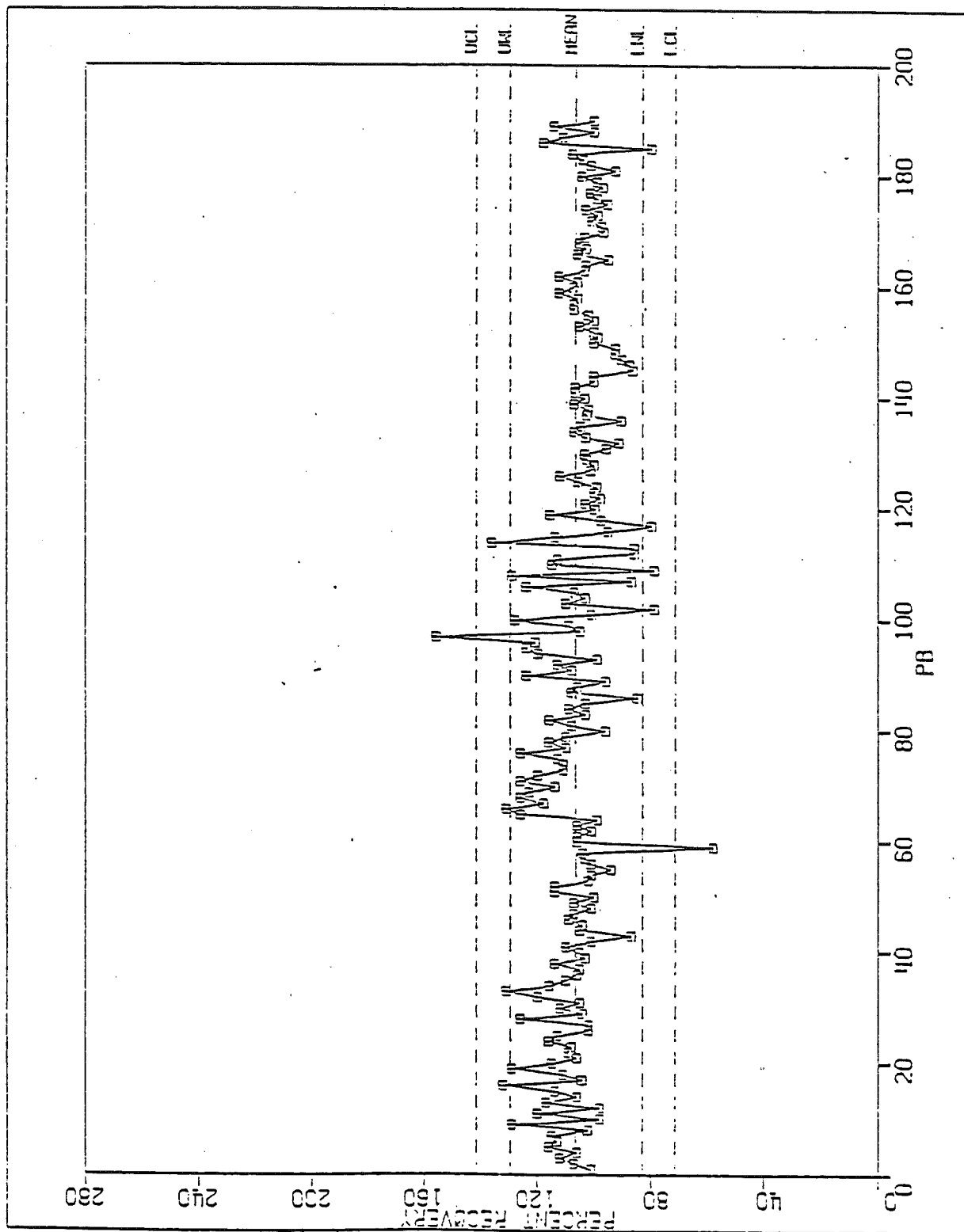
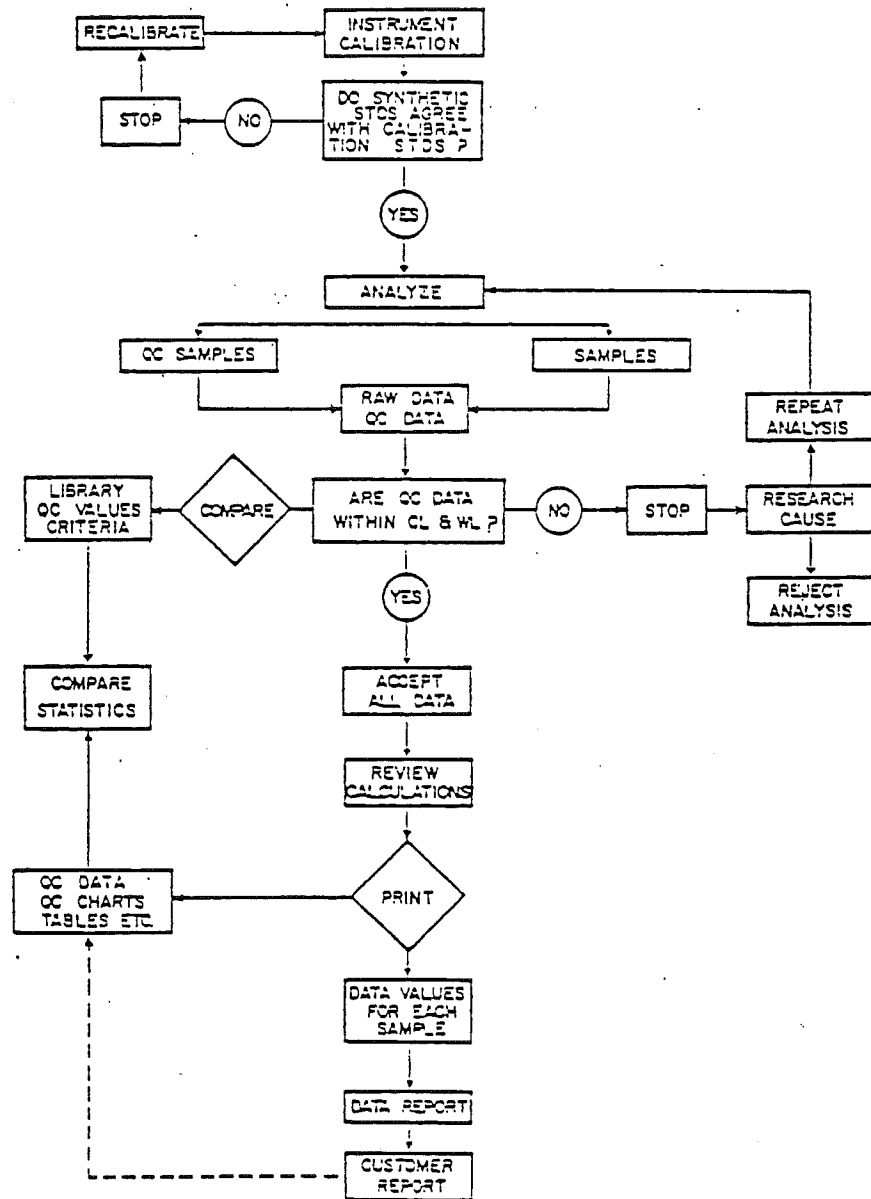


FIGURE 3  
DECISION MAKING PROCESS FOR QA/AC  
PROTOCOL AND ANALYSIS OF SAMPLES



# Safety Protocols



O'BRIEN & GERE

## **SAFETY MANUAL TABLE OF CONTENTS**

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**NOTE: All Appendices are adapted from National Water Well Association "Groundwater Investigations at Hazardous Materials Sites": Safety Short Course**

## I. INTRODUCTION

Every employer is responsible for maintaining safe working conditions for his employees. The purpose of this manual is to provide O'Brien & Gere personnel with a basic framework for safe conduct in performing hazardous waste site investigations. The manual is designed to provide guidance to managing engineers, project managers, project engineers and technicians who will be involved in conducting site surveys, sampling activities and overseeing remediation activities.

This guidance package has been adapted from the United States Environmental Protection Agency "Safety Manual for Hazardous Waste Site Investigations" as published by the Office of Enforcement on September 19, 1979. The procedures have been adapted to meet the general needs of O'Brien & Gere and may be of some use to potential subcontractors for the range of hazardous waste site investigations expected to be undertaken by the Firm.

It should be understood by all who utilize this package that every safety hazard associated with hazardous waste site investigations cannot be covered in this manual. Safe conduct in such investigations must rely on the application of common sense, sound judgment and thorough technical analysis by each member of the project team. Guidance packages represented by this and other supplemental documents cannot be expected to resolve every field-related issue. Only a high level of safety consciousness can be expected to detect and resolve individual issues associated with safe conduct in areas known or suspected to be contaminated with hazardous materials.

Each employee should obtain and read carefully the O'Brien & Gere Safety Manual: copies are available from the personnel manager. In all cases, the employee has the option to decline to undertake the work for safety reasons, until he has performed such preliminary steps so that he can proceed with the work in a safe manner.

No phase of the work is so important, nor is any time restriction so rigid that any employee should sacrifice care or following the rules to gain a few minutes.



## II. RESPONSIBILITY

The responsibility for the development and implementation of safe conduct relative to hazardous waste site investigations and remediation activities rests with each member of the project team and the supporting staff. General responsibilities for particular job classifications are outlined as follows:

### Managing Engineers

Managing Engineers are responsible for the development and overall effectiveness of the safety program identified for each specific hazardous waste site investigation and/or remediation activity. This involves the planning, staffing, allocation of resources, periodic review of procedures and appropriate disciplinary action when unsafe practices are displayed.

### Hazardous Materials Safety Committee

Members of the Hazardous Materials Safety Committee shall be responsible for the review of all site specific safety plans developed by the Managing Engineer. Site work shall not proceed until the committee has approved the specific safety procedures and equipment prepared to be used during work completion. Additionally, the Safety Committee shall:

- advise project team members regarding safety matters
- research and distribute information regarding known hazardous conditions and required practices.
- conduct safety training for members of the project team
- monitors the specific hazardous waste site investigation safety program as required.

### Project Engineer and/or Research Engineer

The principal members of any hazardous waste site investigation project team are assigned project and research engineers. It is this level of the project team which has the responsibility to see that:

- the proper equipment is available and in working order
- proper protective clothing and supplies are available and maintained
- technicians and researchers are updated relative to risks and appropriate precautionary measures
- the safety program is put into practice

- the attention of the Project Manager is immediately called to any unsafe conditions that may exist while conducting field operations
- immediate corrective action is initiated when an unsafe procedure or condition is noted
- a constructive critique relative to safety aspects of the project is provided as required.

### III. GENERAL SAFETY PRECAUTIONS

#### Unsafe Situations

All members of the project team are directed to bring to the attention of the most readily accessible supervisor any unsafe condition, practice, or circumstance associated with or resulting from hazardous waste site investigations.

It is the responsibility of any member of the project team to take all practicable steps to eliminate or neutralize any immediate hazard to employees or the public encountered while conducting field investigations at a hazardous waste site. The Project Manager, Managing Engineer, Division Vice President and Hazardous Waste Safety Committee are to be consulted at the first opportunity. In such a situation the Project Manager, in conjunction with the Managing Engineer, Division Vice President, and Hazardous Waste Safety Committee will at the earliest point in time review those steps necessary to ensure that the investigation can be continued safely. The Project Manager may be required to implement one or more of the following steps:

- changes in procedure
- removal or neutralization of the hazard
- consultation with appropriate specialists (toxicologist, ordinance expert, etc.)
- bringing in specialists such as Explosive Ordinance Disposal units

In cases where the hazard is not immediate, the employee shall consult with the Project Manager and Managing Engineer regarding appropriate corrective measures. The application of good judgment and common sense on the part of all members of the project team is necessary when unsafe conditions are encountered. Any modifications in a sites safety plan and procedures must be approved by the Hazardous Waste Safety Committee prior to implementation.

#### Forbidden Practices

The following practices are expressly forbidden during operations on suspected or known hazardous waste disposal sites:

1. Smoking, eating or drinking while on the site.
2. Ignition of flammable liquids (space heaters, etc.) on the site.
3. Entry onto the site without the required protective equipment.
4. Conduct of on-site operations without sufficient personnel.

5. Entry into areas having radiation levels in excess of 10 mr/hr and explosivity readings greater than 50% LEL.
6. Movement of containers having volumes greater than 5 gallons.
7. Opening sealed vessels without full knowledge of contents and approval of supervisor.
8. Knowingly placing oneself, O'Brien & Gere staff, subcontractor's staff, the public, or the client's staff in any situation which could endanger the health and welfare of such persons.

#### Equipment Inspection

Prior to mobilizing to a site that involves work with potentially hazardous materials, all equipment must be inspected to assure it is in proper working order. This should be completed with a member of the Hazardous Materials Safety Committee. Equipment to be inspected shall include:

- air borne contaminant monitoring instruments
- radioactivity monitoring instruments
- respiratory protective equipment
- protective clothing

#### Health and Training

All employees who will engage in hazardous waste site field investigations must complete a comprehensive health examination. This examination will be paid by the employer, who will receive a written report of the results. The employee must be shown to be free of residual effects of exposure to hazardous materials and be in general good health and physical condition. The comprehensive examination is to be repeated at intervals no greater than annually for so long as the employee continues hazardous waste site investigative work.

All employees engaged in the hazardous waste site field work will receive training in basic first aid, cardio-pulmonary resuscitation and the use of protective clothing and equipment. Management is responsible for providing the necessary training at the earliest practicable time, and refresher training at appropriate times. Each Division Vice President is to identify appropriate staff for required training. The Personnel Manager is responsible for scheduling the training and identifying the appropriate update.

All staff associated with hazardous waste site field work (Division Vice Presidents, Managing Engineers, Project Managers, Project Engineers and Technicians) are required to familiarize themselves with the EPA Occupational Health and Safety Manual, 29 CFR 1910, 29 CFR 1960, and EPA Accident Reporting Procedures.

The law provides that the employer maintain for all time a complete record of every employee exposed to hazardous waste site investigations, including dates, site locations, exposure, physical problems arising and remedies taken at the time and subsequently. This is to ensure lifetime protection for such exposed employees. Diaries will be kept and become a part of job files; such records are to be filed by employees.

#### IV. SAFETY PROCEDURES FOR FIELD EVALUATIONS OF SITES CONTAINING HAZARDOUS MATERIALS

##### Introduction

The Managing Engineer together with his Project Manager is responsible for the development and implementation of the site specific safety plan. Additionally, the Managing Engineer is responsible for obtaining the review and approval of the Hazardous Materials Safety Committee.

The Project Manager ensures that all participants conduct their work in accordance with the safety plan and applicable rules. He is authorized to direct any assigned employee to leave the hazardous waste site if the employee fails to observe safety requirements or in any way creates a safety hazard.

##### Site Specific Safety Plan Development

###### A. Background Information Review

Prior to accessing a site suspected of containing hazardous materials, all available information regarding the types and quantities of potentially hazardous materials on site shall be reviewed. Particular attention should be paid to identified contaminants and their associated health risks. Furthermore, their modes of transportation should also be evaluated with respect to the available data; specifically these are to include:

- air
- surface water/surface runoff
- groundwater system

This information will then be used to develop the preliminary safety plan for the site and determine the diversity of the safety plan as the risks may be different for different on-site activities i.e. test drilling versus sediment sampling. The site should then be classified according to the level of protection required to perform necessary on-site activities safely. The classification system to be used shall be that used by the USEPA which ranges from Level A (highest degree of protection) to Level D (lowest degree of protection). The specific criteria used in the USEPA classification system is included in Appendix A. Information used for site classification shall be documented on Hazardous Substance Data Sheets examples of which are contained in Appendix B. The resultant Site Safety Plan shall then be developed and documented on the forms contained in Appendix C. The Hazardous Substance Data Sheets and Site Safety Plan shall be delivered to all members of the Hazardous Materials Safety Committee for their review. A site specific safety plan shall not be implemented prior to its approval by a majority of the Hazardous Materials Safety Committee members. Subsequent to committee approval, all field crew members shall be instructed as to the site specific safety plan.

## B. Reconnaissance Site Description

Subsequent to the background information review, a site reconnaissance inspection shall be completed to confirm the available data and safety plan adequacy. Additionally, physical site hazards (debris, overhead clearances, equipment accessibility) should be evaluated at this time and reported on the safety plan data sheets.

A detailed discussion of those observations to be made during the reconnaissance inspection is provided in Appendix D. With specific regards to air borne contaminants, however, total organic vapor concentrations shall be monitored throughout the reconnaissance inspection. The detail of this monitoring should be sufficient to identify specific on site "hot spots". The information gathered during the organic vapor survey shall be used to either confirm or redefine respiratory protection. Rational for using total organic vapor concentrations to select respiratory protection is presented in Appendix E.

Should respiratory protection not be warranted at a specific site, chemical respirators or self contained breathing apparatus are still required to be on-site an accessible to crew members at all times.

The need for a reconnaissance inspection may be waived if earlier workers have been on site and the chemical and physical hazards of a site are well documented.

The information review and reconnaissance should also include careful examination of possible hazards to the public. Such hazards may include contamination of groundwater supplies by drilling operations, release of toxic gases, or explosion/fire. Any such hazards must be avoided or eliminated, or appropriate measures must be taken to protect the public and public property. Any indication of the presence of explosives is to be the basis for an initial investigation and appropriate followup by Army Explosive Ordinance Disposal (EOD) personnel or police explosives unit. In the event of a situation dangerous to public safety, field personnel are to immediately notify the responsible managing engineer and civil authorities.

Before entry on a suspect or known hazardous waste site, all investigative personnel must know the locations and emergency telephone numbers for the nearest medical facility, ambulance service, fire department, police department, poison control centers and EPA Office contact.

### Clean Area

During operations on a suspect or known hazardous waste site, a "clean" area must be established outside the area of suspected contamination. At least one backup team member will remain in this area to:

1. Assist in emergency removal of team members from the hazardous waste site in the event of accident or injury. The backup must have readily available protective clothing, breathing apparatus and first aid equipment.
2. Assist in moving equipment, samples, and supplies.

3. Provide communication to emergency units.
4. Assist in decontamination or removal of contaminated clothing from the individuals emerging from the contaminated area.
5. As appropriate, prevent entry of unauthorized persons to the hazardous waste site while operations are underway.
6. Provide other assistance as necessary, but with the primary objective of facilitating safe transfer of personnel and equipment to and from the contaminated area.

#### Sampling Equipment

As a general rule, sampling equipment used on hazardous waste sites should be disposable. Dippers, scoops and similar devices for solids samples should be buried onsite, or placed in plastic bags for disposal or later decontamination. Liquid samples from barrels or tanks should be withdrawn in inert tubing, such as glass, and the tubing should then be broken and abandoned within the barrel or tank. If incineration or recycling of barrel contents is contemplated, the tubing may be disposed of in other suitable containers, or buried on the site. Particular care should be given to the application of the Composite Liquid Waste Sampler (Coliwasa) because it is difficult to decontaminate under field conditions.

#### Clothing

Protective clothing must be worn by all assigned personnel while on a suspected or confirmed hazardous waste site, until sufficient data has been acquired to enable the Project Manager to make an informed judgment regarding the need. Project Managers must weigh the fact that fatigue and alertness on the part of the team members is a significant safety factor. Protective clothing is cumbersome, hastens the on-set of fatigue, and limits stay-time. In the absence of clear indications that work can proceed safely without protective clothing, required items include chemical-resistant pants and jacket, rubber boots, protective gloves, hard hat or head cover, face shield or chemical safety glasses.

Disposable and reusable clothing is available, and each has advantages and disadvantages. The presently available disposable clothing is fragile, easily torn, and especially vulnerable during cold weather. The "bootees" that are furnished with this clothing are highly vulnerable and are of limited value on rough ground or for walking through snagging objects. Reusable clothing is available in much sturdier fabric and is generally preferred. The disadvantage is the necessity for decontamination on-site, or careful packaging, shipment and later decontamination. The reusable suits are worn with heavy rubber slip-on boots, which are easily decontaminated on-site with reagent solution.

Full decontamination of reusable suits is accomplished in two steps. The first step is performed on-site using a reagent solution selected beforehand in consultation with Chemistry and Biology personnel, based on limited knowledge of chemical and biological hazards on the site at that time. After cleaning protective clothing is turned inside out, if feasible, and



sealed in plastic bags for return shipment. The second decontamination step is taken later, after enough of the sample has been laboratory-analyzed to determine what decontamination reagents are most suitable for each case. This second cleaning is then performed by personnel wearing disposable safety clothing. Waste decontamination solution from the second step should be treated as hazardous waste and disposed of according to appropriate regulations.

#### SCBA/Respirators

Self-contained breathing apparatus (SCBA) must be worn on-site when:

- still air conditions prevail
- containers of unknown or known hazardous materials are being opened
- in enclosed spaces, such as unventilated buildings or rooms
- under any circumstances where free-flow of air uncontaminated by toxics is in doubt.

In cases where the Project Manager has determined that on-site work may proceed without use of SCBA, participating personnel must carry respirators having organic vapor protection cartridges, or combination cartridges. An oxygen meter should be used to determine that at least 19.5% oxygen is present in the area where respirators are to be used. Respirators should be donned immediately upon experiencing breathing difficulty, dizziness or other distress, strong taste or smell, or mere judgment that precaution is in order. Once respirators have been donned, team members should withdraw from the site pending a decision by the Project Manager regarding continued operations. Cartridge respirators should not be relied upon for protection from organic vapors for extended periods.

#### Remember:

1. Respirator cartridges for organic vapors function as adsorbants. Once adsorptive capacity is reached, the cartridge no longer functions.
2. Cartridge respirators do not supply oxygen. They are of no use in oxygen deficient atmospheres.

#### Sampling Procedures

Sampling methods are described in the "Waste Disposal Site Hazard Assessment Manual." As indicated under "Field Sampling" above, disposable sampling equipment should be used wherever possible. The guiding safety principle is to prevent exposure of personnel doing sampling, packaging, shipping, analysis, and to prevent exposure of others to spilled or residual waste materials.

Hazardous waste site sample volume should be the smallest consistent with analytical requirements. Sample containers must be cleaned and free of

spilled or residual waste material on the exterior of the container, prior to shipment (see Chapter V - "Shipping of Hazardous Waste Site Samples").

### Leaving the Site

Procedures for leaving the suspect contaminated area must be planned before entry. Provision must be made for: decontamination and safe packing of protective clothing; burial or safe packing of disposable gear; handling of samples and preparation of samples for shipment; transfer of equipment, gear, and samples from the "contaminated" area to the "clean" area; etc. Sequences will depend on several variables -- such as SCBA inside or outside of protective clothing -- but must be worked out in advance. A detailed discussion of acceptable decontamination procedures at different protection levels is contained in Appendix F.

### Training

Field team leaders in hazardous waste site investigations must be provided hands-on training on simulated sites in order to achieve competence in the safety and operational aspects. Preparation for on-site investigations must include detailed briefings, particularly for inexperienced personnel. The requirement for planning and carefully-thought-out sequences must be stressed.

## V. PACKAGING, MARKING, LABELING AND SHIPPING OF HAZARDOUS WASTE SITE SAMPLES

### General Provisions

These procedures apply to samples collected from a hazardous waste site but which in the judgment of the Project Leader cannot be considered to be "environmental" samples.

- Unanalyzed hazardous waste site samples may not be fixed with any preservative or preserved with ice or dry ice.
- If a material specifically identified in the Department of Transportation (DOT) Hazardous Material Table (49 CFR 172.101) is known to be contained in the hazardous waste site sample, that sample should be transported as prescribed in the table. Samples that are judged to be environmental samples may be shipped according to letters of understanding granted OB&G by EPA, DOT or NYSDEC. Other specific exemptions may also apply.
- Unanalyzed hazardous waste site samples may be transported by rented or common carrier truck, bus, railroad, and by Federal Express Corporation (air cargo); but they may not be transported by any other common carrier air transport, even "cargo only" aircraft. Those samples taken from closed drums or tanks, however, should not ordinarily be transported by Federal Express.

Containers (drums, tanks etc.) should be sampled only when necessary to meet enforcement or cleanup requirements. Opening drums or other sealed containers may be hazardous to field personnel unless proper safety procedures are followed. Gases can be released, or pressurized liquids can be expelled. A drum should not be moved or opened unless it can be ascertained beyond reasonable doubt that the drum is structurally sound. Drums standing on end, with bung up, should be opened by pneumatic impact wrench, operated from a remote site. Drums on sides may be opened similarly if it is possible to safely rotate the drum so that the bung is high. If the bung can be removed, sampling contained liquids may be safely accomplished by glass tube, which is then broken and discarded with the barrel. A barrel that has a badly rusted bung, or that cannot be sampled as above, may be safely sample sampled with a hydraulic penetrating device (Figure 3) operated remotely. The device is then abandoned in place, and disassembled to prevent further withdrawal of liquids. Sealed or closed tanks should be opened remotely, using ropes to lift hatches, etc.

In general, metal sample containers should not be used on hazardous waste site investigations; if used, they must be grounded, preferably to the drum or tank being sampled, while sample transfer is accomplished.

In all cases of entry into closed containers, the local fire department should be asked to stand by. In any case wherein presence of explosives is suspected or known, Army EOD or police bomb squads should be requested to remove or neutralize such materials. In no event may

O'Brien & Gere employees or subcontractors handle explosives encountered on dump sites.

Subsurface sampling of hazardous waste sites can also create hazards to employees and the public, unless adequate safety precautions are followed. Biodegradation of refuse in dumps produces methane and other explosive gases. The escaping gases may be ignited by drill rigs or other ignition sources. Drilling into dump sites may cause discarded incompatibles to be mixed and thereby create reactive mixtures. Dump sites where leachate plumes are contained on impervious strata may be interconnected with producing aquifers if drilling is not planned according to competent groundwater technology and data.

Drilling in hazardous waste site investigations should be confined to the periphery of dump sites, with the objective of characterizing the leachate that may be moving away from the site. If subsurface sampling of dump sites is necessary, excavation must be accomplished by hand, and with spark-free equipment.

All drilling associated with hazardous waste site investigations must be accomplished under the responsible supervision of a competent geohydrologist, groundwater geologist, geological engineer, or a person similarly qualified by experience. Drilling must be preceded by sweeps with metal detectors, and drilling must be limited to areas where the presence of buried drums or tanks is not indicated. Test holes must be cased or plugged when the investigation is completed.

Ambient air sampling on hazardous waste sites must be accomplished with spark-free equipment if explosive vapors are present (most hi-vol samplers are spark sources).

Samples from hazardous waste sites must not be preserved, or "fixed," by the addition of chemicals (see "Waste Disposal Site Hazard Assessment Manual" regarding cooling of samples in ice chests or refrigerators).

#### Preliminary Steps

- Conduct a radiation measurement if radiation contamination is suspected to eliminate the possibility of a sample being radioactive.
- Place a sufficient quantity of sample in glass and/or polyethylene containers to determine whether sample material will react with or substantially reduce the effectiveness of the container (this should be done at time of sampling).
- Pack samples according to the "Packaging, Marking and Labeling Requirements for Unanalyzed Hazardous Waste Samples taken from Closed Drums," as discussed below.

#### Packaging, Marking and Labeling Requirements for Unanalyzed Hazardous Waste Site Samples, Excluding Drum Samples

1. Collect sample in a 16-ounce\* or smaller glass or polyethylene container with nonmetallic, teflon-lined screw cap. Allow sufficient ullage

(approximately 10% by volume) so container is not liquid full at 130° F. If collecting a solid material, the container plus contents shall not exceed 1 pound net weight. If sampling for volatile organic analysis (VOA), fill special VOA container to septum but use special cap to accomplish an air space within the container.

2. Attach properly completed sample identification tag to sample container.
3. Seal sample container and place in 2-mil-thick (or thicker) polyethylene bag, one sample per bag. (Tags should be positioned to enable them to be read through bag.)
4. Place sealed bag inside a metal can with incombustible, absorbent cushioning material (e.g., vermiculite or earth) to prevent breakage, one bag per can. Pressure-close the can and use clips, tape or other positive means to hold the lid securely, tightly and effectively.
5. Mark and label this container as indicated in No. 8 below.
6. Mark and label the outside container and complete shipping papers as described in No. 8 below.

#### Marking and Labeling

Use abbreviations only where specified. Place the following information on a metal can (or bottle), either hand printed or in label form: laboratory name and address and "Flammable Liquid, n.o.s.", (if not liquid, write "Flammable Solid, n.o.s."). Place the following labels on the outside of the can (or bottle), next to one another and near the "Flammable liquid, n.o.s." marking:

"Cargo Aircraft Only"; "Flammable Liquid"; (if not liquid, "Flammable Solid" and "Dangerous When Wet").

Note: If the cans are placed in an exterior container, both that container and inside cans must have the same markings and labels as above. "Laboratory Samples" and "THIS SIDE UP" or "THIS END UP" should also be marked on the top of the outside container, and upward pointing arrows should be placed on all four sides of the exterior container.

#### Shipping Papers

Complete the carrier-provided bill of lading and sign the certification statement (if carrier does not provide, use standard industry form) with the following information in the order listed. One form may be used for more than one exterior container, for example:

"Flammable Liquid, n.o.s." (or "Flammable Solid, n.o.s.", as appropriate); "Cargo Aircraft Only"; "Limited Quantity" or "Ltd. Qty."; "Laboratory Samples"; "Net Weight \_\_\_\_\_" or "Net Volume \_\_\_\_\_" (of hazardous contents), by item, if more than one metal can is inside an exterior container. The net weight or net volume must be placed just before or just after the

"Flammable Liquid, n.o.s." or "Flammable Solid, n.o.s." description.

A Chain-of-Custody Record form (Figure 2) should also be properly executed, and included in the exterior container.

#### Packaging, Marking and Labeling Requirements for Unanalyzed Hazardous-Waste Site Samples Taken from Closed Drums

1. All samples from closed drums do not necessarily have to be shipped as below. The Project Coordinator must make a judgement as to the hazard class of samples gathered. This packaging, marking, labeling and shipping method provides a worst-case procedure for materials classed as "Poison A" (49 CFR 173.328).
2. These samples may not be transported by Federal Express Corporation (air cargo) or other common carrier aircraft, or by rental, non-government aircraft. (Samples may be shipped by ground transport or government aircraft.)
3. Collect sample in a polyethylene or glass container which is of an outer diameter narrower than the valve hole on a DOT Spec. 3A1800 or 3AA1800 metal cylinder. Fill sample container allowing sufficient ullage (approximately 10% by volume) so it will not be liquid-full at 130°F. If sampling for volatile organic analysis, fill special VOA container to septum, but use special cap to achieve an air space within the container. Seal sample container.
4. Attach properly completed Sample Identification Tag (Figure 4) to sample container.
5. With a string or flexible wire attached to the neck of the sample container, lower it into a metal cylinder which has been partially filled with incombustible, absorbent, loose packaging material (vermiculite or earth). Allow sufficient cushioning material between the bottom and sides of the container and the metal cylinder to prevent breakage. After the cylinder is filled with cushioning material, drop the ends of the string or wire into the cylinder valve hole. Only one sample container may be placed in a metal cylinder.
6. Replace valve and valve protector on metal cylinder.
7. Mark and label cylinder as described in No. 10 below.
8. One or more cylinders may be placed in a strong outside container.
9. Mark and label outside container and complete shipping papers as described in No. 10 below.

#### Marking and Labeling

Use abbreviations only where specified. Place the following information on the side of the cylinder, or on a tag wired to the cylinder valve protector, either hand-printed or in label form.

10. Unless samples are driven to the laboratory, an OB&G employee will accompany shipping containers to the transport carrier and, if required, open outside container(s) for freight inspection.

"Poisonous Liquid or Gas, n.o.s."; laboratory name and address.\*

Place the following label on the cylinder: "Poisonous Gas". ("Poisonous Liquid" label not acceptable here, even if liquid.)

Note: If the metal cylinders are placed in an outside container, both the container and cylinders inside must have the same markings and labels as above. In addition, "Laboratory Sample", and "Inside Packages Comply With Prescribed Specifications" should be marked on the top of the outside container. "THIS SIDE UP" marking should be placed on the outside container and upward pointing arrows on four sides.

Shipping Papers: Complete the shipper-provided bill of lading and sign the certification statement (if carrier does not provide, use standard industry form) with the following information in the order listed. One form may be used for more than one exterior container; use abbreviations only as specified:

"Poisonous Liquid, n.o.s."; "Limited Quantity" or "Ltd. Qty."; "Laboratory Samples"; "Net Weight \_\_\_\_\_" or "Net Volume \_\_\_\_\_" (of hazardous contents), by cylinder, if more than one cylinder is inside an exterior container. The net weight or net volume must be placed just before or just after the "Poisonous Liquid, n.o.s." marking.

A Chain-of-Custody Record for (Figure 2) should also be properly executed and included in the container.

## VI. SUMMARY

Human safety should be the first priority in activities related to Hazardous Waste Site Investigations. In all cases, the employee has the option to decline to undertake the work for safety reasons, until he has performed such preliminary steps so that he can proceed with the work in a safe manner.

When hauling samples in O'Brien & Gere vehicles, drivers should be especially cautious. Whether the vehicle has a total collision (self-only) or impact with another vehicle, specific actions can be taken. Consideration should be taken concerning the samples themselves should they be spilled or catch fire. Drivers in all cases should look to self preservation, first and foremost. Subsequently, police should be notified immediately; the area should be isolated; and the home office should be contacted for further instructions.

"This manual has been prepared for and distributed to employees and is solely for their guidance. No other corporations or persons may use all or parts of the manual without the express written permission of O'Brien & Gere Engineers, Inc."



APPENDIX A

LEVELS OF PROTECTION

## APPENDIX A

### LEVELS OF PROTECTION

#### I. INTRODUCTION

Personnel must wear protective equipment when response activities involve known or suspected atmospheric contamination, when vapors, gases, or particulates may be generated, or when direct contact with skin-affecting substances may occur. Respirators can protect lungs, gastrointestinal tract, and eyes against air toxicants. Chemical-resistant clothing can protect the skin from contact with skin-destructive and -absorbable chemicals. Good personal hygiene limits or prevents ingestion of material.

Equipment to protect the body against contact with known or anticipated chemical hazards has been divided into four categories according to the degree of protection afforded:

- Level A: Should be worn when the highest level of respiratory, skin, and eye protection is needed.
- Level B: Should be selected when the highest level of respiratory protection is needed, but a lesser level of skin protection. Level B protection is the minimum level recommended on initial site entries until the hazards have been further defined by on-site studies and appropriate personnel protection utilized.
- Level C: Should be selected when the type(s) of airborne substance(s) is known, the concentration(s) is measured, and the criteria for using air-purifying respirators are met.
- Level D: Should not be worn on any site with respiratory or skin hazards. Is primarily a work uniform providing minimal protection.

The Level of Protection selected should be based primarily on:

- Type(s) and measured concentration(s) of the chemical substance(s) in the ambient atmosphere and its toxicity.
- Potential or measured exposure to substances in air, splashes of liquids, or other direct contact with material due to work being performed.

In situations where the type(s) of chemical(s), concentration(s), and possibilities of contact are not known, the appropriate Level of Protection must be selected based on professional experience and judgment until the hazards can be better characterized.

While personnel protective equipment reduces the potential for contact with harmful substances, ensuring the health and safety of response personnel requires, in addition, safe work practices, decontamination, site entry

protocols, and other safety considerations. Together, these protocols establish a combined approach for reducing potential harm to workers.

## II. LEVELS OF PROTECTION

### A. Level A Protection

#### 1. Personnel protective equipment

- Pressure-demand, self-contained breathing apparatus, approved by the Mine Safety and Health Administration (MSHA) and National Institute of Occupational Safety and Health (NIOSH).
- Fully encapsulating chemical-resistant suit
- Coveralls\*
- Long cotton underwear\*
- Gloves (outer), chemical-resistant
- Gloves (inner), chemical-resistant
- Boots, chemical-resistant, steel toe and shank. (Depending on suit construction, worn over or under suit boot)
- Hard hat\* (under suit)
- Disposable protective suit, gloves, and boots\* (Worn over fully encapsulating suit)
- 2-Way radio communications (intrinsically safe)

#### 2. Criteria for selection

Meeting any of these criteria warrants use of Level A Protection:

- The chemical substance(s) has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on:
  - measured (or potential for) high concentration(s) of atmospheric vapors, gases, or particulates
  - or
  - site operations and work functions involving high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates.

\*Optional

- Extremely hazardous substances (for example: dioxin, cyanide compounds, concentrated pesticides, Department of Transportation Poison "A" materials, suspected carcinogens, and infectious substances) are known or suspected to be present, and skin contact is possible.
- The potential exists for contact with substances that destroy skin.
- Operations must be conducted in confined, poorly ventilated areas until the absence of hazards requiring Level A protection is demonstrated.
- Total atmospheric readings on the Century OVA System, HNU Photoionizer, and similar instruments indicate 500-1,000 ppm of unidentified substances. (See Appendixes I and II.)

### 3. Guidance on selection criteria

The fully encapsulating suit provides the highest degree of protection to skin, eyes, and respiratory system if the suit material is resistant to the chemical(s) of concern during the time the suit is worn and/or at the measured or anticipated concentrations. While Level A provides maximum protection, the suit material may be rapidly permeated and penetrated by certain chemicals from extremely high air concentrations, splashes, or immersion of boots or gloves in concentrated liquids or sludges. These limitations should be recognized when specifying the type of chemical-resistant garment. Whenever possible, the suit material should be matched with the substance it is used to protect against.

The use of Level A protection and other chemical-resistant clothing requires evaluating the problems of physical stress, in particular heat stress associated with the wearing of impermeable protective clothing. Response personnel must be carefully monitored for physical tolerance and recovery.

Protective equipment being heavy and cumbersome, decreases dexterity, agility, visual acuity, etc., and so increases the probability of accidents. This probability decreases as less protective equipment is required. Thus, increased probability of accidents should be considered when selecting a Level of Protection.

Many toxic substances are difficult to detect or measure in the field. When such substances (especially those readily absorbed by or destructive to the skin) are known or suspected to be present and personnel contact is unavoidable, Level A protection should be worn until more accurate information can be obtained.

### 3. Level B Protection

#### 1. Personal protective equipment

- Pressure-demand, self-contained breathing apparatus (MSHA/NIOSH approved)

- Chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; hooded, one or two-piece chemical-splash suit; disposable chemical-resistant coveralls)
- Coveralls\*
- Gloves (outer), chemical-resistant
- Gloves (inner), chemical-resistant
- Boots (outer), chemical-resistant, steel toe and shank
- Boots (outer), chemical-resistant (disposable)\*
- Hard hat (face shield\*)
- 2-Way radio communications (intrinsically safe)

## 2. Criteria for selection

Meeting any one of these criteria warrants use of Level B protection:

- The type(s) and atmospheric concentration(s) of toxic substances have been identified and require the highest level of respiratory protection, but a lower level of skin and eye protection. These would be atmospheres:
  - with concentrations Immediately Dangerous to Life and Health (IDLH)
  - or
  - exceeding limits of protection afforded by a full-face, air-purifying mask
  - or
  - containing substances for which air-purifying canisters do not exist or have low removal efficiency
  - or
  - containing substances requiring air-supplied equipment, but substances and/or concentrations do not represent a serious skin hazard.
- The atmosphere contains less than 19.5% oxygen.
- Site operations make it highly unlikely that the small, unprotected area of the head or neck will be contacted by splashes of extremely hazardous substances.

\*Optional

- Total atmospheric concentrations of unidentified vapors or gases range from 5 ppm to 500 ppm on instruments such as the Century OVA System or HNU Photoionizer, and vapors are not suspected of containing high levels of chemicals toxic to skin. (See Appendixes I and II.)

### 3. Guidance on selection criteria

Level B equipment provides a high level of protection to the respiratory tract, but a somewhat lower level of protection to skin. The chemical-resistant clothing required in Level B is available in a wide variety of styles, materials, construction detail, permeability, etc. These factors all affect the degree of protection afforded. Therefore, a specialist should select the most effective chemical-resistant clothing (and fully encapsulating suit) based on the known or anticipated hazards and/or job function.

Generally, if a self-contained breathing apparatus is required, Level B clothing rather than a Level A fully encapsulating suit is selected, based on the protection needed against known or anticipated substances affecting the skin. Level B skin protection is selected by:

- Comparing the concentrations of known or identified substances in air with skin toxicity data.
- Determining the presence of substances that are destructive to and/or readily absorbed through the skin by liquid splashes, unexpected high levels of gases or particulates, or other means of direct contact.
- Assessing the effect of the substance (at its measured air concentrations or splash potential) on the small area of the head and neck unprotected by chemical-resistant clothing.

For initial site entry and reconnaissance at an open site, approaching whenever possible from the upwind direction, Level B protection (with good quality, hooded, chemical-resistant clothing) should protect response personnel, providing the conditions described in selecting Level A are known or judged to be absent. For continuous operations, the aforementioned criteria must be evaluated.

At 500 ppm total vapors/gases, upgrading to Level A protection may be advisable. A major factor for re-evaluation is the presence of vapors, gases, or particulates requiring a higher degree of skin protection.

### Level C Protection

#### 1. Personal protective equipment

- Full-face, air-purifying, canister-equipped respirator (MSHA/NIOSH approved)
- Chemical-resistant clothing (coveralls; hooded, two-piece chemical

splash suit; chemical-resistant hood and apron; disposable chemical-resistant coveralls)

- Coveralls\*
- Gloves (outer), chemical-resistant
- Gloves (inner), chemical-resistant\*
- Boots (outer), chemical-resistant, steel toe and shank\*
- Boots (outer), chemical-resistant (disposable)\*
- Hard hat (face shield\*)
- Escape mask\*
- 2-Way radio communications (intrinsically safe)

## 2. Criteria for selection

Meeting all of these criteria permits use of Level C protection:

- Measured air concentrations of identified substances will be reduced by the respirator to at or below the substance's exposure limit, and the concentration is within the service limit of the canister.
- Atmospheric contaminant concentrations do not exceed IDLH levels.
- Atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect the small area of skin left unprotected by chemical-resistant clothing.
- Job functions have been determined not to require self-contained breathing apparatus.
- Total vapor readings register between background and 5 ppm above background on instruments such as the HNU Photoionizer and Century OVA System. (See Appendixes I and II.)
- Air will be monitored periodically.

## 3. Guidance on selection criteria

Level C protection is distinguished from Level B by the equipment used to protect the respiratory system, assuming the same type of chemical-resistant clothing is used. The main selection criterion for Level C is that conditions permit wearing air-purifying devices.

The air-purifying device must be a full-face mask (MSHA/NIOSH approved) equipped with a canister suspended from the chin or on a harness. Canisters

\*Optional

must be able to remove the substances encountered. Quarter- or half-masks or cheek-cartridge full-face masks should be used only with the approval of a qualified individual.

In addition, a full-face, air-purifying mask can be used only if:

- Oxygen content of the atmosphere is at least 19.5% by volume.
- Substance(s) is identified and its concentration(s) measured.
- Substance(s) has adequate warning properties.
- Individual passes a qualitative fit-test for the mask.
- Appropriate cartridge/canister is used, and its service limit concentration is not exceeded.

An air monitoring program is part of all response operations when atmospheric contamination is known or suspected. It is particularly important that the air be monitored thoroughly when personnel are wearing air-purifying respirators (Level C). Continual surveillance using direct-reading instruments and air sampling is needed to detect any changes in air quality necessitating a higher level of respiratory protection. See Part 8 for guidance on air monitoring.

Total unidentified vapor/gas concentrations of 5 ppm above background require Level B protection. Only a qualified individual should select Level C (air-purifying respirators) protection for continual use in an unidentified vapor/gas concentration of background to 5 ppm above background.

#### D. Level D Protection

##### 1. Personal protective equipment

- Coveralls
- Gloves\*
- Boots/shoes, leather or chemical-resistant, steel toe and shank
- Boots (outer), chemical-resistant (disposable)\*
- Safety glasses or chemical splash goggles\*
- Hard hat (face shield)\*
- Escape mask\*

##### 2. Criteria for selection

Meeting any of these criteria allows use of Level D protection:

No hazardous air pollutants have been measured.

Optional



Work functions preclude splashes, immersion, or potential for unexpected inhalation of any chemicals.

### 3. Guidance on selection criteria

Level D protection is primarily a work uniform. It can be worn in areas where: 1) only boots can be contaminated, or 2) there are no inhalable toxic substances.

## III. PROTECTION IN UNKNOWN ENVIRONMENTS

In all site operations, selecting the appropriate personnel protection equipment is one of the first steps in reducing the potential for adverse health effects. Until the hazardous conditions presented by an environmental incident can be identified and personnel safety measures commensurate with the hazards - real or potential - instituted, preliminary measures will have to be based on applying experience, judgment, and professional knowledge to the particular incident at hand. Lack of knowledge concerning the hazards that could be encountered precludes selecting protective equipment by comparing environmental concentrations of known toxicants against protection afforded by each type of equipment.

One of the first considerations in evaluating the risk of an unknown environment is to measure immediate atmospheric hazards such as the concentrations (or potential concentrations) of vapors, gases, and particulates; oxygen content of the air; explosive potential; and, to a lesser degree, the possibility of radiation exposure. In addition to air measurements, visual observation and/or evaluation of existing data can help determine the degree of risk from other materials that are explosive, have a high fire potential, are extremely toxic, or exhibit other hazardous characteristics that cannot be monitored by field instruments.

Total vapor/gas concentration as indicated by instruments such as the Century OVA System or the HNU Photoionizer is a useful adjunct to professional judgment in selecting the Level of Protection to be worn in an unknown environment. It should not be the sole criterion, but should be considered with all other available information. Total vapor/gas concentration should be applied only by qualified persons thoroughly familiar with the information contained in Appendixes I and II.

The initial on-site survey and reconnaissance, which may consist of more than one entry, is to characterize the immediate hazards and, based on these findings, establish preliminary safety requirements. As data are obtained from the initial survey, the Level of Protection and other safety procedures are adjusted. Initial data also provide information on which to base further monitoring and sampling. No method can select a Level of Protection in all unknown environments. Each situation must be examined individually. Some general approaches can be given, however, for judging the situation and determining the Level of Protection required.

- Entering cloud of chlorine released in a railroad accident.
- Handling and moving drums suspected and/or known to contain substances that were skin destructive or absorbable.
- Responding to accidents involving cyanide, arsenic, or undiluted pesticides.

#### C. Level B

While Level B protection does not afford the maximum skin (and eye) protection as does a fully encapsulating suit, a good quality, hooded, chemical-resistant, one-or-two-piece garment, with taped joints, provides a reasonably high degree of protection. At most abandoned hazardous waste sites, ambient atmospheric gas/vapor levels have not approached concentrations sufficiently high to warrant maximum protection. In all but a few circumstances, Level B should provide the protection needed for initial entry. Subsequent operations require a re-evaluation of Level B based on the probability of being splashed by chemicals, their effect on the skin, or the presence of hard-to-detect air contaminants.

### IV. ADDITIONAL CONSIDERATIONS

In addition to the topics previously addressed, there are other factors which should be considered in selecting the appropriate Level of Protection.

#### A. Protective Clothing

No adequate criteria are available, similar to the respiratory protection decision-logic, for selecting protective clothing. A concentration of a known substance in the air approaching a TLV or permissible exposure limit for the skin does not automatically warrant a fully encapsulating suit. A hooded, high quality, chemical-resistant suit may provide adequate protection. The selection of Level A over Level B is a judgment that should be made by a qualified individual considering the following factors:

- Effect of the material on skin:
  - highly hazardous substances are those that are easily absorbed through the skin, causing systemic effects, or that cause severe skin destruction. Liquids are generally more hazardous than vapors/gases and particulates.
  - less hazardous substances are those that are not easily absorbed through the skin, causing systemic effects, or that cause severe skin destruction.

#### A. Level C

Level C protection (full-face, air-purifying respirator) should be worn routinely in an atmosphere only after the type(s) of air contaminant(s) is identified and concentrations measured. To permit flexibility in prescribing a Level of Protection at certain environmental incidents, a specialist could consider air-purifying respirators for use in unidentified vapor/gas concentrations of a few parts per million. The guideline of total vapor/gas concentration of background to 5 ppm above background should not be the sole criterion for selecting Level C. Since the individual contributors may never be completely identified, a decision on continuous wearing of Level C must be made, after assessing all safety considerations, including:

- The presence of (or potential for) organic or inorganic vapors/gases against which a canister is ineffective or has a short service life.
- The known (or suspected) presence in air of substances with low TLV or IDLH levels.
- The presence of particulates in air.
- The errors associated with both the instruments and monitoring procedures used.
- The presence of (or potential for) substances in air which do not elicit a response on the instrument(s) used.
- The potential for higher concentrations in the ambient atmosphere or in the air adjacent to specific site operations.

The continuous use of air-purifying respirators (Level C) should be based on the identification of the substances contributing to the total vapor/gas concentration and the application of published criteria for the routine use of air-purifying devices. Unidentified ambient concentrations of organic vapors or gases in air approaching or exceeding 5 ppm above background require Level B protection.

Individuals without appropriate training and/or experience should be discouraged from modifying upward the recommended total vapor/gas concentration guideline and associated Levels of Protection.

#### B. Level A

Level A should be worn when maximum protection is needed against substances that could damage the surface of the skin and/or be absorbed through the skin. Since Level A requires the use of a self-contained breathing apparatus, the eyes and respiratory system are also protected. For initial site entry, skin toxicants would exist primarily as vapors, gases, or particulates in air, with a lesser

possibility of splash. Continuous operations at an abandoned waste site, for instance, may require Level A due to working with and around severe skin toxicants.

Until air monitoring data are available to assist in the selection of the appropriate Level of Protection, the use of Level A for initial site entries may have to be based on indirect evidence of the potential for atmospheric contamination or direct skin contact.

Considerations that may require Level A protection include:

- Confined spaces: Enclosed, confined, or poorly ventilated areas are conducive to buildup in air of toxic vapors, gases, or particulates. (Explosive or oxygen-deficient atmospheres also are more probable in confined spaces.) Low-lying outdoor areas - ravines, ditches, and gulleys - tend to accumulate any heavier-than-air vapors or gases present.
- Suspected/known toxic substances: Various substances may be known or suspected to be involved in an incident, but there are no field instruments available to detect or quantify air concentrations. In these cases, media samples must be analyzed in the laboratory. Until these substances are identified and levels measured, maximum protection may be necessary.
- Visible emissions: Visible emissions from leaking containers or railroad/vehicular tank cars, as well as smoke from chemical fires, indicate high potential for concentration of substances that could be extreme respiratory or skin hazards.
- Job functions: Initial site entries are generally walk-throughs in which instruments and/or visual observations provide a preliminary characterization of the hazards. Subsequent entries are to conduct the many activities needed to reduce the environmental impact of those hazards. Levels of Protection for later operations are based not only on data obtained from the initial and subsequent environmental monitoring, but also on the probability of contamination. Maximum protection (Level A) should be worn when:
  - there is a high probability for exposure to high concentrations of vapors, gases, or particulates.
  - substances could splash.
  - substances are known or suspected of being extremely toxic directly to the skin or by being absorbed.

Examples of situations where Level A has been worn are:

- Excavating of soil suspected of being contaminated with dioxin.

APPENDIX B

HAZARDOUS SUBSTANCE DATA SHEET

## HAZARDOUS SUBSTANCE DATA SHEET

NAME OF SUBSTANCE: \_\_\_\_\_

COMMON: \_\_\_\_\_

CHEMICAL: \_\_\_\_\_

## I. PHYSICAL/CHEMICAL PROPERTIES

SOURCE

Normal physical state: \_\_\_\_\_

Molecular weight \_\_\_\_\_

Density \_\_\_\_\_

Specific gravity \_\_\_\_\_

Solubility: (water) \_\_\_\_\_

Solubility: \_\_\_\_\_

Boiling point \_\_\_\_\_

Melting point \_\_\_\_\_

Vapor pressure \_\_\_\_\_

Vapor density \_\_\_\_\_

Flash point \_\_\_\_\_

Autoignition point \_\_\_\_\_

Other: \_\_\_\_\_

Gas \_\_\_\_\_ Liquid \_\_\_\_\_ Solid \_\_\_\_\_

gm/ml

OF/OC

OF/OC

OF/OC

OF/OC

OF/OC

OF/OC

mmHg

OF/OC

OF/OC

OF/OC

OF/OC

OF/OC

## II. HAZARDOUS CHARACTERISTICS

TOXICOLOGICALHAZARDCONCENTRATIONSSOURCE

Inhalation Yes No

Ingestion Yes No

Skin/eye absorpt. Yes No

Skin/eye contact Yes No

Carcinogenicity Yes No

Teratogenicity Yes No

Mutagenicity Yes No

Aquatic Yes No

Other: Yes No

FIRECONCENTRATIONSSOURCE

Combustibility Yes No

Toxic byproducts Yes No

EXPLOSIVENESS Yes No

LEL

UEL

<u>REACTIVITY</u>	<u>HAZARD</u>		<u>CONCENTRATIONS</u>	<u>SOURCE</u>
	Yes	No		
_____			_____	_____
_____			_____	_____
<u>CORROSIVENESS</u>				
pH _____	Yes	No	_____	_____
Neutralizing agent: _____			_____	_____
_____			_____	_____
<u>RADIOACTIVE</u>	Yes	No	<u>EXPOSURE RATE</u>	<u>SOURCE</u>
Alpha radiation			_____	_____
Beta radiation			_____	_____
Gamma radiation			_____	_____
Natural (background) radiation			_____	_____

### III. INCIDENT RELATED:

Quantity involved \_\_\_\_\_

Information released on \_\_\_\_\_

\_\_\_\_\_

Monitoring/sampling recommended \_\_\_\_\_

\_\_\_\_\_

Public \_\_\_\_\_

\_\_\_\_\_

Environment \_\_\_\_\_

\_\_\_\_\_

Worker \_\_\_\_\_

\_\_\_\_\_

## EMERGENCY HAND SIGNALS

1. Hand gripping throat: Out of air, can't breath.
2. Grip partner's wrist or place both hands around waist: Leave area immediately, no debate!
3. Hands on top of head: Need assistance.
4. Thumbs up: OK, I'm all right, I understand.
5. Thumbs down: No, negative.



APPENDIX C

SITE/AREA SAFETY PLAN

# SITE/AREA SAFETY PLAN

(use last page if additional space is necessary)

## GENERAL

DATES PLAN IN USE: \_\_\_\_\_ DATE PREPARED: \_\_\_\_\_  
PREPARED BY: \_\_\_\_\_ SITE/AREA NAME: \_\_\_\_\_  
LOCATION: \_\_\_\_\_

EXISTING INFORMATION FOR SITE: DETAILED \_\_\_\_\_ PRELIMINARY \_\_\_\_\_ SKETCHY \_\_\_\_\_ NONE \_\_\_\_\_

HAZARDOUS MATERIAL FORM: GAS \_\_\_\_\_ LIQUID \_\_\_\_\_ SLUDGE \_\_\_\_\_ SOLID \_\_\_\_\_

CONTAINMENT: DRUM \_\_\_\_\_ PIT \_\_\_\_\_ POND \_\_\_\_\_ LAGOON \_\_\_\_\_ TANK \_\_\_\_\_ SOILS \_\_\_\_\_ DEBRIS \_\_\_\_\_  
OTHER \_\_\_\_\_ CONDITION \_\_\_\_\_

CHARACTERISTICS: CORROSIVE \_\_\_\_\_ IGNITABLE \_\_\_\_\_ RADIOACTIVE \_\_\_\_\_ VOLATILE \_\_\_\_\_ TOXIC \_\_\_\_\_  
REACTIVE \_\_\_\_\_ OTHER \_\_\_\_\_ UNKNOWN \_\_\_\_\_

## SITE/AREA SPECIFICS

### HIGH HAZARD MATERIAL:

COMPOUND	ANTICIPATED CONCENTRATION	WARNING PROPERTIES
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

SITE HISTORY: TOPOGRAPHY \_\_\_\_\_

STATUS: OPEN \_\_\_\_\_ CLOSED \_\_\_\_\_ LIMITED ACCESS \_\_\_\_\_ UNKNOWN \_\_\_\_\_

HISTORY (regulatory action, local complaints, injuries, site controls):

\_\_\_\_\_  
\_\_\_\_\_

UNUSUAL FEATURES (control feature integrity, utilities, obstacles):

\_\_\_\_\_  
\_\_\_\_\_

## HAZARD ASSESSMENT

EVALUATION OF EXPECTED HAZARD (work assignments, operational considerations, routes of exposure, health effects, material stability):

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

OPERATIONAL PROCEDURES

SITE COMMAND AND CONTROL (include sketch or map as appropriate):

PERIMETER CONTROL \_\_\_\_\_

STAGING AREA \_\_\_\_\_

EQUIPMENT REQUIREMENTS \_\_\_\_\_

PERSONNEL PROTECTION

GENERAL LEVEL OF PROTECTION REQUIRED: A \_\_\_\_ B \_\_\_\_ C \_\_\_\_ D \_\_\_\_

MODIFICATION OR SPECIALIZED EQUIPMENT: \_\_\_\_\_

DETECTION EQUIPMENT (survey meters, dosimeters):

COMMUNICATIONS (type, range, frequencies, alternates, hand signals):

AUTHORIZED TEAM PERSONNEL

NAME	POSITION	MEDICAL(date)	TRAINING(type,date)

OTHER PERSONNEL (prearranged visitors, support personnel):

NAME	AGENCY/COMPANY	RESTRICTIONS

MONITORING PROCEDURES (use and employment of fixed, portable, real-time, continuous and/or periodic monitoring devices):

DECONTAMINATION PROCEDURES (include sketch of exclusion, contamination reduction and support zones): PERSONNEL \_\_\_\_\_

PERSONNEL PROTECTIVE EQUIPMENT \_\_\_\_\_

SAMPLING EQUIPMENT \_\_\_\_\_

SUPPORT EQUIPMENT \_\_\_\_\_

DECON MATERIALS REQUIRED (containers, decon solutions): \_\_\_\_\_

SPECIAL HAZARDS: \_\_\_\_\_

#### EMERGENCY PROCEDURES

HIGH HAZARD MATERIALS (known or anticipated):

NAME

ACUTE EXPOSURE SYMPTOMS

FIRST AID

LOCATION OF NEAREST WORKING PHONE \_\_\_\_\_

OTHER EMERGENCY COMMUNICATIONS \_\_\_\_\_

#### EMERGENCY PHONE NUMBERS:

NAME/LOCATION

PHONE #

PREPLAN/STANBY

AMBULANCE \_\_\_\_\_

FIRE \_\_\_\_\_

POLICE \_\_\_\_\_

HOSPITAL \_\_\_\_\_

EOD \_\_\_\_\_

ENVIRONMENTAL \_\_\_\_\_

UTILITIES \_\_\_\_\_

ADDITIONAL RESOURCES:

NAME

AGENCY/COMPANY

PHONE #

ROUTE TO HOSPITAL

ALTERNATIVE

EQUIPMENT CHECKLIST

PROTECTIVE AND SAFETY EQUIPMENT (model, type, material, amount required):

SCBA \_\_\_\_\_ SPARE CYLINDERS \_\_\_\_\_  
ESCAPE MASK \_\_\_\_\_ CHEM-MECH RESPIRATORS \_\_\_\_\_  
FULL FACE \_\_\_\_\_ HALF FACE \_\_\_\_\_  
CANISTER \_\_\_\_\_ CARTRIDGE \_\_\_\_\_  
HARDHAT \_\_\_\_\_ FACE SHIELD \_\_\_\_\_ CHEM GOGGLES \_\_\_\_\_  
SAFETY GLASSES \_\_\_\_\_ EAR PROTECTION \_\_\_\_\_  
GLOVES: SURGICAL \_\_\_\_\_ CHEM \_\_\_\_\_ OUTER \_\_\_\_\_  
CHEM RESIST COVERALLS \_\_\_\_\_ DISPOSAL COVERALLS \_\_\_\_\_  
SPLASH APRONS \_\_\_\_\_ SPLASH SUITS \_\_\_\_\_  
BOOTS \_\_\_\_\_ BOOT/SHOE COVERS \_\_\_\_\_  
FULLY ENCAPSULATED SUITS \_\_\_\_\_  
DOSIMETERS \_\_\_\_\_  
FIRST AID EQUIPMENT \_\_\_\_\_  
EYE WASH STATION \_\_\_\_\_ FIRE EXTINGUISHER \_\_\_\_\_  
DECON MATERIALS \_\_\_\_\_  
SAFETY HARNESS \_\_\_\_\_ SPECIAL TOOLS \_\_\_\_\_  
OTHER \_\_\_\_\_

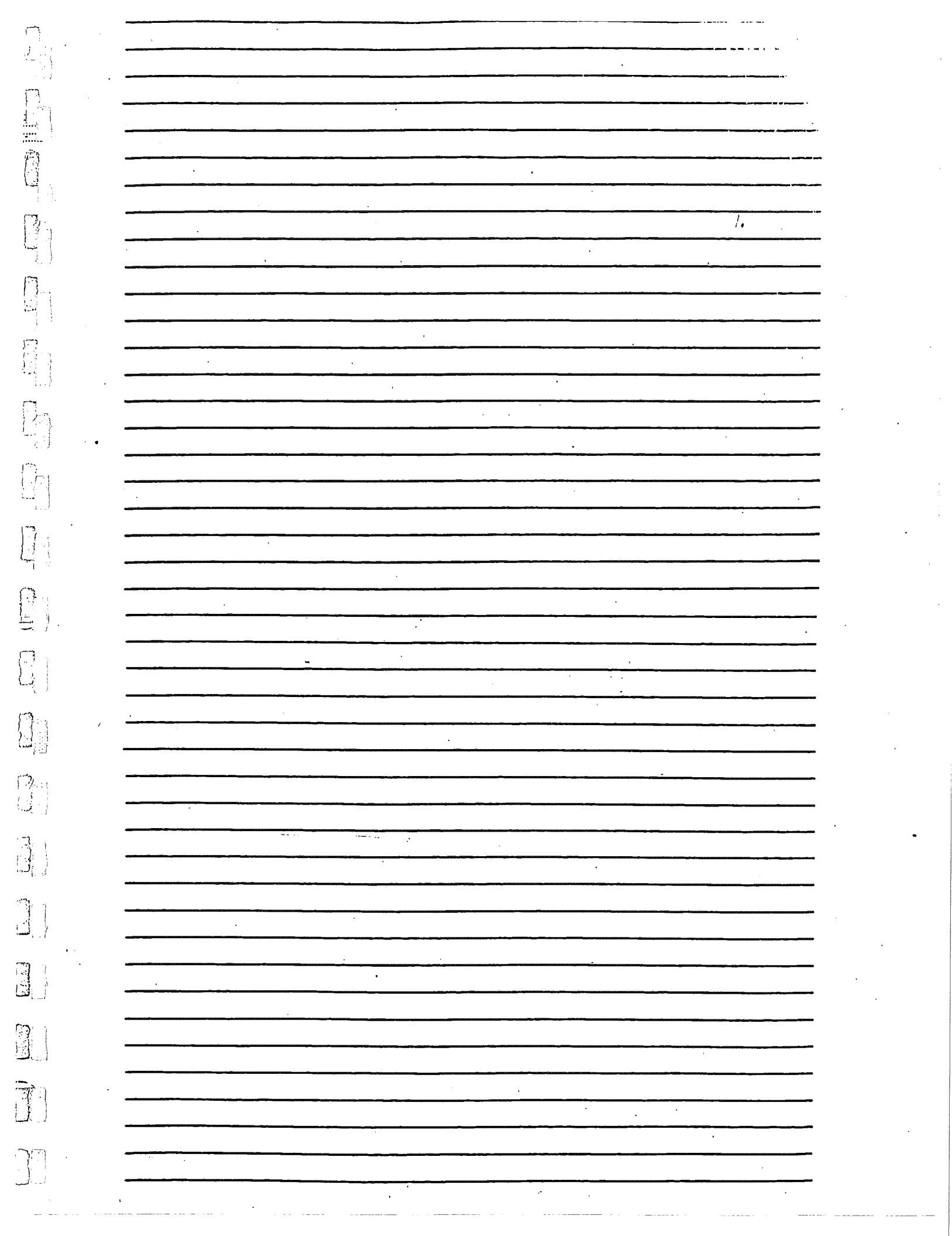
AFTER ACTION REPORT TO

DATE

POST SITE MEDICALS

PLAN APPROVED BY

DATE



APPENDIX D

SITE ENTRY - SURVEY AND RECONNAISSANCE

## SITE ENTRY - SURVEY AND RECONNAISSANCE

### I. INTRODUCTION

The team(s) initially entering the site is to accomplish one or more of the following objectives:

- Characterize the hazards that exist or potentially exist affecting the public health, the environment, and response personnel.
- Verify existing information and/or obtain data about the incident.
- Evaluate the need for prompt mitigation actions.
- Collect supplemental information to determine the safety requirements for personnel initially and subsequently entering the site.

Before the team enters the site, as much information as possible should be collected, depending on the time available, concerning the type(s) of hazards, degree of hazard(s), and risks which may exist. Based upon available information (shipping manifests, transportation placards, existing records, container labels, etc.) or off-site studies, the team assesses the hazards, determines the need to go on-site, and identifies initial safety requirements.

### II. PRELIMINARY ON-SITE EVALUATION

The initial on-site survey is to determine, on a preliminary basis, hazardous or potentially hazardous conditions. The main effort is to rapidly identify the immediate hazards that may affect the public, response personnel, and the environment. Of major concern are the real or potential dangers - for example, fire, explosion, oxygen-deficient atmospheres, radiation, airborne contaminants, containerized or pooled hazardous substances, that could affect workers during subsequent operations.

#### A. Organic Vapors and Gases

If the type(s) of organic substance(s) involved in an incident is known and the material is volatile or can become airborne, air measurements for organics should be made with one or more appropriate, properly calibrated survey instruments.

When the presence or types of organic vapors/gases are unknown, instruments such as a photoionizer (HNU Systems\*) and/or a portable gas chromatograph (Century Systems OVA\*), operated in the total readout

\*The use of any trade names does not imply their endorsement by the U.S. Environmental Protection Agency.



mode, should be used to detect organic vapors. Until specific constituents can be identified, the readout indicates total airborne substances to which the instrument is responding. Identification of the individual vapor/gas constituents permits the instruments to be calibrated and used for more specific analysis.

Sufficient data should be obtained during the initial entry to map or screen the site for various levels of organic vapors. These gross measurements can be used on a preliminary basis to: 1) determine levels of personnel protection, 2) establish site work zones, and 3) select candidate areas for more thorough qualitative and quantitative studies.

Higher than background readings on the HNU or OVA may also indicate the displacement of oxygen or the presence of combustible vapors.

#### B. Inorganic Vapors and Gases

The ability to detect and quantify nonspecific inorganic vapors and gases is extremely limited. Presently, the HNU photoionizer has limited detection capability while the Century Systems has none. (See Appendix I for characteristics). If specific inorganics are known or suspected to be present, measurements should be made with appropriate instruments, if available. Colorimetric tubes can be used if substances present are known (or can be narrowed to a few) and appropriate tubes are available.

#### C. Radiation

Although radiation monitoring is not necessary for all responses, it should be incorporated in the initial survey where radioactive materials may be present - for example, fires at warehouses or hazardous material storage facilities, transportation incidents involving unknown materials, or abandoned waste sites.

Normal gamma radiation background is approximately 0.01 to 0.02 milliroentgen per hour (mR/hr) on a gamma survey instrument. Work can continue with elevated radiation exposure rates; however, if the exposure rate increases to 3-5 times above gamma background, a qualified health physicist should be consulted. At no time should work continue with an exposure rate of 10 mR/hr or above without the advice of a health physicist. EPA's Office of Air, Noise, and Radiation has radiation specialists in each Region, as well as at Headquarters, Montgomery, Alabama, and Las Vegas, Nevada, to assist.

The absence of gamma readings above background should not be interpreted as the complete absence of radioactivity. Radioactive materials emitting low-energy gamma, alpha, or beta radiation may be present, but for a number of reasons may not cause a response on the instrument. Unless airborne, these radioactive materials should present minimal hazard, but more thorough surveys should be conducted

as site operations continue to completely eliminate the presence of any radioactive material.

#### D. Oxygen Deficiency

At sea level, ambient air must contain at least 19.5% by volume of oxygen. At lower percentages, air-supplied respiratory protective equipment is needed. Oxygen measurements are of particular importance for work in enclosed spaces, low-lying areas, or in the vicinity of accidents that have produced heavier-than-air vapors, which could displace ambient air. These oxygen-deficient areas are also prime locations for taking further organic vapor and combustible gas measurements, since the air has been displaced by other substances. Oxygen-enriched atmospheres increase the potential for fires.

#### E. Combustible Gases

The presence or absence of combustible vapors or gases must be determined. If readings approach or exceed 10% of the lower explosive limit (LEL), extreme caution should be exercised in continuing the investigation. If readings approach or exceed 25% LEL, personnel should be withdrawn immediately. Before resuming any on-site activities, project personnel in consultation with experts in fire or explosion prevention must develop procedures for continuing operations.

#### F. Visual Observations

While on-site, the initial entry team should make visual observations which would help in evaluating site hazards - for example, dead fish or other animals; land features; wind direction; labels on containers indicating explosive, flammable, toxic, or corrosive materials; conditions conducive to splash or contact with unconfined liquids, sludges, or solids; and other general conditions.

#### G. Direct-Reading Instruments

A variety of toxic air pollutants, (including organic and inorganic vapors, gases, or particulates) can be produced at, for example, abandoned waste sites; fires at chemical manufacturing, storage, reprocessing, or formulating facilities; or fires involving pesticides. Direct-reading field instruments will not detect or measure all of these substances. Thus, negative readings should not be interpreted as the complete absence of airborne toxic substances. Verification of negative results can only be done by collecting air samples and analyzing them in a laboratory.

### III. OTHER CONSIDERATIONS

#### A. Initial Surveys

In general, the initial entry is considered a relatively rapid screening process for collecting preliminary data on site hazards. The time needed to conduct the initial survey depends on the urgency of the situation, type of incident, information needed, size of site, availability of resources, level of protection required for initial entry personnel, etc. Consequently, initial surveys may need hours or days to complete and consist of more than one entry.

#### B. Priority for Initial Entry Monitoring

Of immediate concern to initial entry personnel are atmospheric conditions which could affect their immediate safety. These conditions are airborne toxic substances, combustible gases or vapors, lack of oxygen, and to a lesser extent, ionizing radiation. Priorities for monitoring these potential hazards should be established after a careful evaluation of conditions.

When the type(s) of material(s) involved in an incident is identified and its release into the environment suspected or known, the material's chemical/physical properties and the prevailing weather conditions may help determine the order of monitoring. An unknown substance(s) or situation(s) presents a more difficult monitoring problem.

In general, for poorly ventilated spaces - buildings, ship's holds, boxcars, or bulk tanks - which must be entered, combustible vapors/gases and oxygen-deficient atmospheres should be monitored first with team members wearing, as a minimum, Level B protective equipment (Levels of Protection are described in Part 5). Toxic gases/vapors and radiation, unless known not to be present, should be measured as the next priority.

For open, well-ventilated areas, combustible gases and oxygen deficiency are lesser hazards, and require lower priority. However, areas of lower elevation on-site (such as ditches and gulleys) and downwind areas may have combustible gas mixtures, in addition to toxic vapors or gases, and lack sufficient oxygen to sustain life. Entry teams should approach and monitor whenever possible from the upwind area.

#### C. Periodic Monitoring

The monitoring surveys made during the initial site entry phase are for a preliminary evaluation of atmospheric hazards. In some situations, the information obtained may be sufficient to preclude additional monitoring - for example, a chlorine tank determined to be releasing no chlorine. Materials detected during the initial site

survey call for a more comprehensive evaluation of hazards and analyses for specific components. A program must be established for monitoring, sampling, and evaluating hazards for the duration of site operations. Since site activities and weather conditions change, a continuous program to monitor atmospheric changes must be implemented utilizing a combination of stationary sampling equipment, personnel monitoring devices, and periodic area monitoring with direct-reading instruments.

#### D. Peripheral Monitoring

Whenever possible, atmospheric hazards in the areas adjacent to the on-site zone should be monitored with direct-reading instruments, and air samples should be taken before the initial entry for on-site monitoring. Negative instrument readings off-site should not be construed as definite indications of on-site conditions, but only another piece of information to assist in the preliminary evaluation.

#### E. Monitoring Instruments

It is imperative that personnel using monitoring instruments be thoroughly familiar with their use, limitations, and operating characteristics. All instruments have inherent constraints in their ability to detect and/or quantify the hazards for which they were designed. Unless trained personnel use instruments and assess data readout, air hazards can be grossly misinterpreted, endangering the health and safety of response personnel. In addition, only intrinsically safe instruments should be used, until the absence of combustible gases or vapors can be confirmed.

#### F. Ambient Atmospheric Concentrations

Any indication of atmospheric hazards - toxic substances, combustible gases, lack of oxygen, radiation, and other specific materials - should be viewed as a sign to proceed with care and deliberation. Readings indicating nonexplosive atmospheres, low concentrations of toxic substances, or other conditions may increase or decrease suddenly, changing the associated risks. Extreme caution should be exercised in continuing surveys when atmospheric hazards are indicated.

TABLE 4-1  
ATMOSPHERIC HAZARD GUIDELINES

Monitoring Equipment	Hazard	Ambient Level	Action
Combustible gas indicator	Explosive atmosphere	< 10% LEL	Continue investigation.
		10%-25%	Continue on-site monitoring with extreme caution as higher levels are encountered.
		> 25% LEL	Explosion hazard; withdraw from area immediately.
Oxygen concentration meter	Oxygen	< 19.5%	Monitor wearing SCBA. NOTE: Combustible gas readings are not valid in atmospheres with < 19.5% oxygen.
		19.5%-25%	Continue investigation with caution. SCBA not needed, based on oxygen content only.
		> 25.0%	Discontinue inspection; fire hazard potential. Consult specialist.
Radiation survey	Radiation	< 1 mR/hr	Continue investigation. If radiation is detected above background levels, this signifies the presence of possible radiation sources; at this level, more thorough monitoring is advisable. Consult with a health physicist.
		> 10 mR/hr	Potential radiation hazard; evacuate site. Continue monitoring only upon the advice of a health physicist.
Colorimetric tubes	Organic and inorganic vapors/gases	Depends on species	Consult standard reference manuals for air concentrations/toxicity data.

TABLE 4-1 (Continued)

HNU photoionizer	Organic vapors/gases	1) Depends on species	Consult standard reference manuals for air concentrations/toxicity data.
		2) Total response mode	Consult EPA Standard Operating Procedures.
Organic vapor analyzer	Organic	1) Depends on species	Consult standard reference manuals for air concentrations/toxicity data.
		2) Total response mode	Consult EPA Standard Operating Procedures.

APPENDIX E

RATIONALE FOR RELATING TOTAL ATMOSPHERIC VAPOR/GAS CONCENTRATIONS  
TO THE SELECTION OF THE LEVEL OF PROTECTION

# RATIONALE FOR RELATING TOTAL ATMOSPHERIC VAPOR/GAS CONCENTRATIONS TO THE SELECTION OF THE LEVEL OF PROTECTION

## I. INTRODUCTION

The objective of using total atmospheric vapor/gas concentrations for determining the appropriate Level of Protection is to provide a numerical criterion for selecting Level A, B, or C. In situations where the presence of vapors or gases is not known, or if present, the individual components are unknown, personnel required to enter that environment must be protected. Until the constituent substances and corresponding atmospheric concentrations of vapor, gas, or particulate can be determined and respiratory and/or body protection related to the toxicological properties of the identified substances, total vapor/gas concentration, with judicious interpretation, can be used as a guide for selecting personnel protection equipment.

Although total vapor/gas concentration measurements are useful to a qualified professional for the selection of protection equipment, caution should be exercised in interpretation. An instrument does not respond with the same sensitivity to several vapor/gas contaminants as it does to a single contaminant. Also since total vapor/gas field instruments see all contaminants in relation to a specific calibration gas, the concentration of unknown gases or vapors may be over - or under-estimated.

Suspected carcinogens, particulates, highly hazardous substances, or other substances that do not elicit an instrument response may be known or believed to be present. Therefore, the protection level should not be based solely on the total vapor/gas criterion. Rather, the level should be selected case-by-case, with special emphasis on potential exposure and chemical and toxicological characteristics of the known or suspected material.

## II. FACTORS FOR CONSIDERATION

In utilizing total atmospheric vapor/gas concentrations as a guide for selecting a Level of Protection, a number of other factors should also be considered:

- The uses, limitations, and operating characteristics of the monitoring instruments must be recognized and understood. Instruments such as the HNU Photoionizer, Century Organic Vapor Analyzer (OVA), MIRAN Infrared Spectrophotometer, and others do not respond identically to the same concentration of a substance or respond to all substances. Therefore, experience, knowledge, and good judgment must be used to complement the data obtained with instruments.



- Other hazards may exist such as gases not detected by the HNU or OVA, (i.e. phosgene, cyanides, arsenic, chlorine), explosives, flammable materials, oxygen deficiency, liquid/solid particles, and liquid or solid chemicals.
- Vapors/gases with very low toxicities could be present.
- The risk to personnel entering an area must be weighed against the need for entering. Although this assessment is largely a value judgment, it requires a conscientious balancing of the variables involved and the risk to personnel against the need to enter an unknown environment.
- The knowledge that suspected carcinogens or substances extremely toxic or destructive to skin are present or suspected to be present (which may not be reflected in total vapor/gas concentration) requires an evaluation of factors such as the potential for exposure, chemical characteristics of the material, limitation of instruments, and other considerations specific to the incident.
- What needs to be done on-site must be evaluated. Based upon total atmospheric vapor concentrations, Level C protection may be judged adequate; however, tasks such as moving drums, opening containers, and bulking of materials, which increase the probability of liquid splashes or generation of vapors, gases, or particulates, may require a higher level of protection.
- Before any respiratory protective apparatus is issued, a respiratory protection program must be developed and implemented according to recognized standards (ANSI Z88.2-1980).

### III. LEVEL A PROTECTION (500 to 1,000 PPM ABOVE BACKGROUND)

Level A protection provides the highest degree of respiratory tract, skin, and eye protection if the inherent limitations of the personnel protective equipment are not exceeded. The range of 500 to 1,000 parts per million (ppm) total vapors/gases concentration in air was selected based on the following criteria:

- Although Level A provides protection against air concentrations greater than 1,000 ppm for most substances, an operational restriction of 1,000 ppm is established as a warning flag to:
  - evaluate the need to enter environments with unknown concentrations greater than 1,000 ppm
  - identify the specific constituents contributing to the total concentration and their associated toxic properties
  - determine more precisely concentrations of constituents

- evaluate the calibration and/or sensitivity error associated with the instrument(s)
- evaluate instrument sensitivity to wind velocity, humidity temperature, etc.

- A lower limit of 500 ppm total vapors/gases in air was selected as the value to consider upgrading from Level B to Level A. This concentration was selected to fully protect the skin until the constituents can be identified and measured and substances affecting the skin excluded.

- The range of 500 to 1,000 ppm is sufficiently conservative to provide a safe margin of protection if readings are low due to instrument error, calibration, and sensitivity; if higher than anticipated concentrations occur; and if substances highly toxic to the skin are present.

With properly operating portable field equipment, ambient air concentrations approaching 500 ppm have not routinely been encountered on hazardous waste sites. High concentrations have been encountered only in closed buildings, when containers were being opened, when personnel were working in the spilled contaminants, or when organic vapors/gases were released in transportation accidents. A decision to require Level A protection should also consider the negative aspects: higher probability of accidents due to cumbersome equipment, and most importantly, the physical stress caused by heat buildup in fully encapsulating suits.

#### IV. LEVEL B PROTECTION (5 to 500 ABOVE BACKGROUND)

Level B protection is the minimum Level of Protection recommended for initially entering an open site where the type(s), concentration(s), and presence of airborne vapors are unknown. This Level of Protection provides a high degree of respiratory protection. Skin and eyes are also protected, although a small portion of the body (neck and sides of head) may be exposed. The use of a separate hood or hooded, chemical-resistant jacket would further reduce the potential for exposure to this area of the body. Level B impermeable protective clothing also increases the probability of heat stress.

A limit of 500 ppm total atmospheric vapor/gas concentration on portable field instruments has been selected as the upper restriction on the use of Level B. Although Level B personnel protection should be adequate for most commonly encountered substances at air concentrations higher than 500 ppm, this limit has been selected as a decision point for a careful evaluation of the risks associated with higher concentrations. These factors should be considered:

- The necessity for entering unknown concentrations higher than 500 ppm wearing Level B protection.
- The probability that substance(s) present are severe skin hazards.

- The work to be done and the increased probability of exposure.
- The need for qualitative and quantitative identification of the specific components.
- Inherent limitations of the instruments used for air monitoring.
- Instrument sensitivity to winds, humidity, temperature, and other factors.

#### V. LEVEL C PROTECTION (BACKGROUND TO 5 PPM ABOVE BACKGROUND)

Level C provides skin protection identical to Level B, assuming the same type of chemical protective clothing is worn, but lesser protection against inhalation hazards. A range of background to 5 ppm above ambient background concentrations of vapors/gases in the atmosphere has been established as guidance for selecting Level C protection. Concentrations in the air of unidentified vapors/gases approaching or exceeding 5 ppm would warrant upgrading respiratory protection to a self-contained breathing apparatus.

A full-face, air-purifying mask equipped with an organic vapor canister (or a combined organic vapor/particulate canister) provides protection against low concentrations of most common organic vapors/gases. There are some substances against which full-face, canister-equipped masks do not protect, or substances that have very low Threshold Limit Values or Immediately Dangerous to Life or Health concentrations. Many of the latter substances are gases or liquids in their normal state. Gases would only be found in gas cylinders, while the liquids would not ordinarily be found in standard containers or drums.

Every effort should be made to identify the individual constituents (and the presence of particulates) contributing to the total vapor readings of a few parts per million. Respiratory protective equipment can then be selected accordingly. It is exceedingly difficult, however, to provide constant, real-time identification of all components in a vapor cloud with concentrations of a few parts per million at a site where ambient concentrations are constantly changing. If highly toxic substances have been ruled out, but ambient levels of a few parts per million persist, it is unreasonable to assume only self-contained breathing apparatus should be worn. The continuous use of air-purifying masks in vapor/gas concentrations of a few parts per million gives a reasonable assurance that the respiratory tract is protected, provided that the absence of highly toxic substances has been confirmed.

Full-face, air-purifying devices provide respiratory protection against most vapors at greater than 5 ppm; however, until more definitive qualitative information is available, concentration(s) greater than 5 ppm indicates that a higher level of respiratory protection should be used. Also, unanticipated transient excursions may increase the concentrations in

the environment above the limits of air-purifying devices. The increased probability of exposure due to the work being done may require Level B protection, even though ambient levels are low.

## VI. INSTRUMENT SENSITIVITY

Although the measurement of total vapor/gas concentrations can be a useful adjunct to professional judgment in the selection of an appropriate Level of Protection, caution should be used in the interpretation of the measuring instrument's readout. The response of an instrument to a gas or vapor cloud containing two or more substances does not provide the same sensitivity as measurements involving the individual pure constituents. Hence the instrument readout may overestimate or underestimate the concentration of an unknown composite cloud. This same type of inaccuracy could also occur in measuring a single unknown substance with the instrument calibrated to a different substance. The idiosyncrasies of each instrument must be considered in conjunction with the other parameters in selecting the protection equipment needed.

Using the total vapor/gas concentration as a criterion used to determine Levels of Protection should provide protection against concentrations greater than the instrument's readout. However, when the upper limits of Level C and B are approached, serious consideration should be given to selecting a higher Level of Protection. Cloud constituent(s) must be identified as rapidly as possible and Levels of Protection based on the toxic properties of the specific substance(s) identified.

APPENDIX F

SITE CONTROL - DECONTAMINATION

## SITE CONTROL - DECONTAMINATION

### I. INTRODUCTION

Personnel responding to hazardous substance incidents may become contaminated in a number of ways, including:

- Contacting vapors, gases, mists, or particulates in the air.
- Being splashed by materials while sampling or opening containers.
- Walking through puddles of liquids or on contaminated soil.
- Using contaminated instruments or equipment.

Protective clothing and respirators help prevent the wearer from becoming contaminated or inhaling contaminants, while good work practices help reduce contamination on protective clothing, instruments, and equipment.

Even with these safeguards, contamination may occur. Harmful materials can be transferred into clean areas, exposing unprotected personnel. Or in removing contaminated clothing, personnel may contact contaminants on the clothing and/or inhale them. To prevent such occurrences, methods to reduce contamination and decontamination procedures must be developed and implemented before anyone enters a site and must continue (modified when necessary) throughout site operations.

Decontamination consists of physically removing contaminants and/or changing their chemical nature to innocuous substances. How extensive decontamination must be depends on a number of factors, the most important being the type of contaminants involved. The more harmful the contaminant the more extensive and thorough decontamination must be. Less harmful contaminants may require less decontamination. Combining decontamination, the correct method of doffing personnel protective equipment, and the use of site work zones minimizes cross-contamination from protective clothing to wearer, equipment to personnel, and one area to another. Only general guidance can be given on methods and techniques for decontamination. The exact procedure to use must be determined after evaluating a number of factors specific to the incident.

### II. PRELIMINARY CONCERNS

#### A. Initial Planning

The initial decontamination plan assumes all personnel and equipment leaving the Exclusion Zone (area of potential contamination) are grossly contaminated. A system is then set up to wash and rinse,

at least once, all the personnel protective equipment worn. This is done in combination with a sequential doffing of equipment, starting at the first station with the most heavily contaminated item and progressing to the last station with the least contaminated article. Each piece of clothing or operation requires a separate station.

The spread of contaminants during the washing/doffing process is further reduced by separating each decontamination station by a minimum of 3 feet. Ideally, contamination should decrease as a person moves from one station to another farther along in the line.

While planning site operations, methods should be developed to prevent the contamination of people and equipment. For example, using remote sampling techniques, not opening containers by hand, bagging monitoring instruments, using drum grapplers, watering down dusty areas, and not walking through areas of obvious contamination would reduce the probability of becoming contaminated and require a less elaborate decontamination procedure.

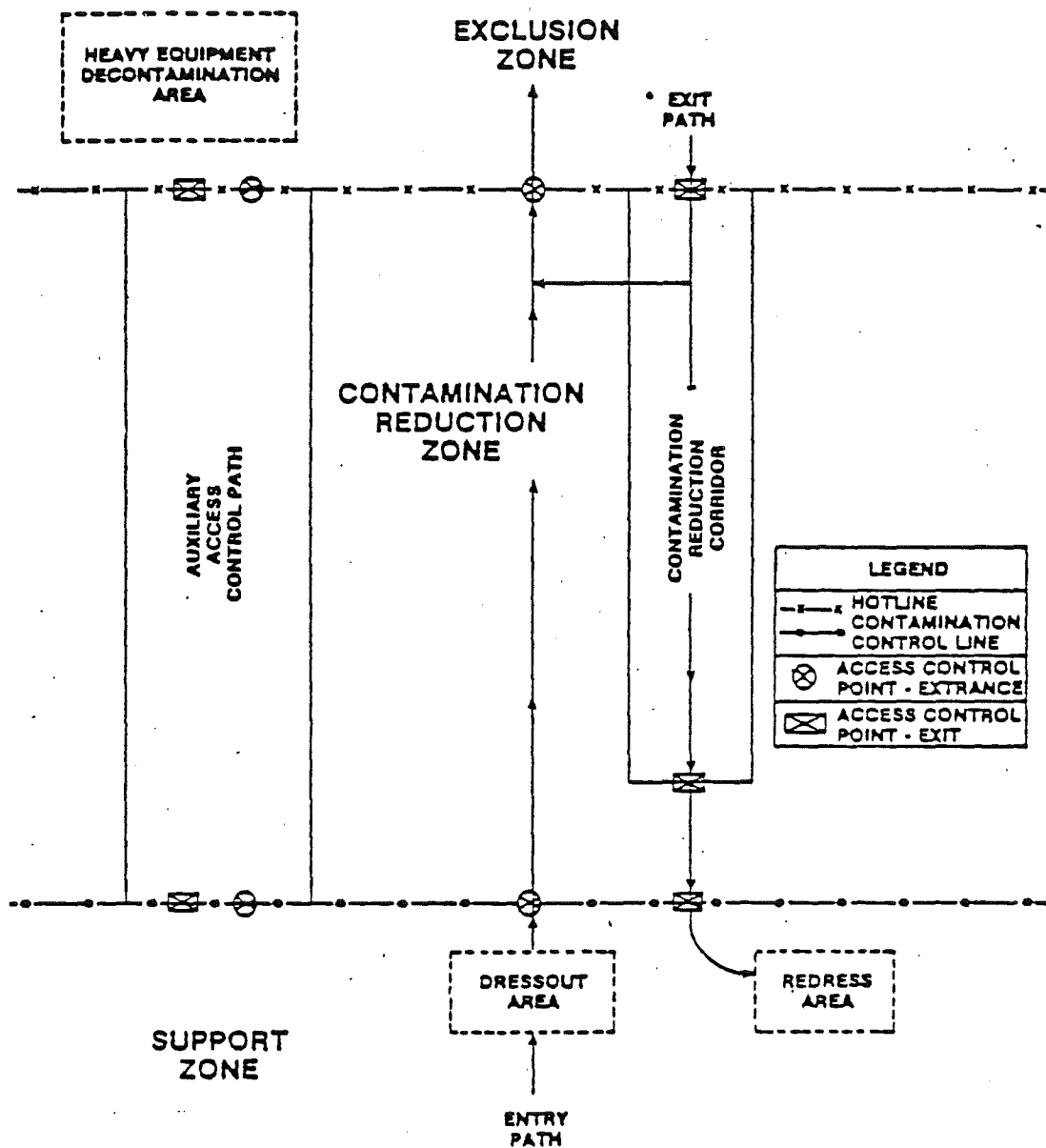
The initial decontamination plan is based on a worst-case situation (if no information is available about the incident). Specific conditions at the site are then evaluated, including:

- Type of contaminant.
- The amount of contamination.
- Levels of protection required.
- Type of protective clothing worn.

The initial system is modified, eliminating unnecessary stations or otherwise adapting it to site conditions. For instance, the initial plan might require a complete wash and rinse of chemical protective garments. If disposable garments are worn, the wash/rinse step could be omitted. Wearing disposable boot covers and gloves could eliminate washing and rinsing both gloves and disposable boots and reduce the number of stations needed.

#### B. Contamination Reduction Corridor

An area within the Contamination Reduction Zone is designated the Contamination Reduction Corridor (CRC). The CRC controls access into and out of the Exclusion Zone and confines personnel decontamination activities to a limited area. The size of the corridor depends on the number of stations in the decontamination procedure, overall dimensions of work control zones, and amount of space available at the site. A corridor of 75 feet by 15 feet should be adequate for full decontamination. Whenever possible, it should be a straight path.



CONTAMINATION REDUCTION ZONE LAYOUT  
FIGURE 7-1



The CRC boundaries should be conspicuously marked, with entry and exit restricted. The far end is the hotline - the boundary between the Exclusion Zone and the Contamination Reduction Zone. Personnel exiting the Exclusion Zone must go through the CRC. Anyone in the CRC should be wearing the Level of Protection designated for the decontamination crew. Another corridor may be required for the entrance and exit of heavy equipment needing decontamination. Within the CRC, distinct areas are set aside for decontamination of personnel, portable field equipment, removed clothing, etc. These areas should be marked and personnel restricted to those wearing the appropriate Level of Protection. All activities within the corridor are confined to decontamination.

Personnel protective clothing, respirators, monitoring equipment, sampling supplies, etc. are all maintained outside of the CRC. Personnel don their protective equipment away from the CRC and enter the Exclusion Zone through a separate access control point at the hotline.

### III. EXTENT OF DECONTAMINATION REQUIRED

#### A. Modifications of Initial Plan

The original decontamination plan must be adapted to specific conditions found at incidents. These conditions may require more or less personnel decontamination than planned, depending on a number of factors.

##### 1. Type of Contaminant

The extent of personnel decontamination depends on the effects the contaminants have on the body. Contaminants do not exhibit the same degree of toxicity (or other hazard). The more toxic a substance is the more extensive or thorough decontamination must be. Whenever it is known or suspected that personnel can become contaminated with highly toxic or skin-destructive substances, a full decontamination procedure should be followed. If less hazardous materials are involved, the procedure can be downgraded.

##### 2. Amount of Contamination

The amount of contamination on protective clothing is usually determined visually. If it is badly contaminated, a thorough decontamination is generally required. Gross material remaining on the protective clothing for any extended period of time may degrade or permeate it. This likelihood increases with higher air concentrations and greater amounts of liquid contamination. Gross contamination also increases the probability of personnel contact. Swipe tests may help determine the type and quantity of surface contaminants.

### 3. Level of Protection

The Level of Protection and specific pieces of clothing worn determine on a preliminary basis the layout of the decontamination line. Each Level of Protection incorporates different problems in decontamination and doffing of the equipment. For example: decontamination of the harness straps and backpack assembly of the self-contained breathing apparatus is difficult. A butyl rubber apron worn over the harness makes decontamination easier. Clothing variations and different Levels of Protection may require adding or deleting stations in the original decontamination procedure.

### 4. Work Function

The work each person does determines the potential for contact with hazardous materials. In turn, this dictates the layout of the decontamination line. Observers, photographers, operators of air samplers, or others in the Exclusion Zone performing tasks that will not bring them in contact with contaminants may not need, for example, to have their garments washed and rinsed. Others in the Exclusion Zone with a potential for direct contact with the hazardous material will require more thorough decontamination. Different decontamination lines could be set up for different job functions, or certain stations in a line could be omitted for personnel performing certain tasks.

### 5. Location of Contamination

Contamination on the upper areas of protective clothing poses a greater risk to the worker because volatile compounds may generate a hazardous breathing concentration both for the worker and for the decontamination personnel. There is also an increased probability of contact with skin when doffing the upper part of clothing.

### 6. Reason for Leaving Site

The reason for leaving the Exclusion Zone also determines the need and extent of decontamination. A worker leaving the Exclusion Zone to pick up or drop off tools or instruments and immediately returning may not require decontamination. A worker leaving to get a new air cylinder or change a respirator or canisters, however, may require some degree of decontamination. Individuals departing the CRC for a break, lunch, end of day, etc., must be thoroughly decontaminated.

## B. Effectiveness of Decontamination

There is no method to immediately determine how effective decontamination is in removing contaminants. Discolorations, stains, corrosive effects, and substances adhering to objects may indicate contaminants have not been removed. However, observable effects only

indicate surface contamination and not permeation (absorption) into clothing. Also many contaminants are not easily observed.

A method for determining effectiveness of surface decontamination is swipe testing. Cloth or paper patches - swipes - are wiped over predetermined surfaces of the suspect object and analyzed in a laboratory. Both the inner and outer surfaces of protective clothing should be swipe tested. Positive indications of both sets of swipes would indicate surface contamination has not been removed and substances have penetrated or permeated through the garment. Swipe tests can also be done on skin or inside clothing. Permeation of protective garments requires laboratory analysis of a piece of the material. Both swipe and permeation testing provide after-the-fact information. Along with visual observations, results of these tests can help evaluate the effectiveness of decontamination.

#### C. Equipment

Decontamination equipment, materials, and supplies are generally selected based on availability. Other considerations are ease of equipment decontamination or disposability. Most equipment and supplies can be easily procured. For example, soft-bristle scrub brushes or long-handle brushes are used to remove contaminants. Water in buckets or garden sprayers is used for rinsing. Large galvanized wash tubs or stock tanks can hold wash and rinse solutions. Children's wading pools can also be used. Large plastic garbage cans or other similar containers lined with plastic bags store contaminated clothing and equipment. Contaminated liquids can be stored temporarily in metal or plastic cans or drums. Other gear includes paper or cloth towels for drying protective clothing and equipment.

#### D. Decontamination Solution

Personnel protective equipment, sampling tools, and other equipment are usually decontaminated by scrubbing with detergent-water using a soft-bristle brush followed by rinsing with copious amounts of water. While this process may not be fully effective in removing some contaminants (or in a few cases, contaminants may react with water), it is a relatively safe option compared with using a chemical decontaminating solution. This requires that the contaminant be identified. A decon chemical is then needed that will change the contaminant into a less harmful substance. Especially troublesome are unknown substances or mixtures from a variety of known or unknown substances. The appropriate decontamination solution must be selected in consultation with an experienced chemist.

#### E. Establishment of Procedures

Once decontamination procedures have been established, all personnel requiring decontamination must be given precise instructions (and practice, if necessary). Compliance must be frequently checked. The

time it takes for decontamination must be ascertained. Personnel wearing SCBA's must leave their work area with sufficient air to walk to CRC and go through decontamination.

#### IV. DECONTAMINATION DURING MEDICAL EMERGENCIES

##### A. Basic Considerations

Part of overall planning for incident response is managing medical emergencies. The plan should provide for:

- Some response team members fully trained in first aid and CPR.
- Arrangements with the nearest medical facility for transportation and treatment of injured, and for treatment of personnel suffering from exposure to chemicals.
- Consultation services with a toxicologist.
- Emergency eye washes, showers, and/or wash stations.
- First aid kits, blankets, stretcher, and resuscitator.

In addition, the plan should have established methods for decontaminating personnel with medical problems and injuries. Their is the possibility that the decontamination may aggravate or cause more serious health effects. If prompt life-saving first aid and/or medical treatment is required, decontamination procedures should be omitted. Whenever possible, response personnel should accompany contaminated victims to the medical facility to advise on matters involving decontamination.

##### B. Physical Injury

Physical injuries can range from a sprained ankle to a compound fracture, from a minor cut to massive bleeding. Depending on the seriousness of the injury, treatment may be given at the site by trained response personnel. For more serious injuries, additional assistance may be required at the site or the victim may have to be treated at a medical facility.

Life-saving care should be instituted immediately without considering decontamination. The outside garments can be removed (depending on the weather) if they do not cause delays, interfere with treatment, or aggravate the problem. Respiratory masks and backpack assemblies must always be removed. Fully encapsulating suits or chemical-resistant clothing can be cut away. If the outer contaminated garments cannot be safely removed, the individual should be wrapped in plastic, rubber, or blankets to help prevent contaminating the inside of ambulances and/or medical personnel. Outside garments are then removed at the medical

facility. No attempt should be made to wash or rinse the victim. One exception would be if it is known that the individual has been contaminated with an extremely toxic or corrosive material which could also cause severe injury or loss of life. For minor medical problems or injuries, the normal decontamination procedure should be followed.

#### C. Heat Stress

Heat-related illnesses range from heat fatigue to heat stroke, the most serious. Heat stroke requires prompt treatment to prevent irreversible damage or death. Protective clothing may have to be cut off. Less serious forms of heat stress require prompt attention or they may lead to a heat stroke. Unless the victim is obviously contaminated, decontamination should be omitted or minimized and treatment begun immediately.

#### D. Chemical Exposure

Exposure to chemicals can be divided into two categories:

- Injuries from direct contact, such as acid burns or inhalation of toxic chemicals.
- Potential injury due to gross contamination on clothing or equipment.

For the contaminant inhaled, treatment can only be by qualified physicians. If the contaminant is on the skin or in the eyes, immediate measures must be taken to counteract the substance's effect. First aid treatment usually is flooding the affected area with water; however, for a few chemicals, water may cause more severe problems.

When protective clothing is grossly contaminated, contaminants may be transferred to treatment personnel or the wearer and cause injuries. Unless severe medical problems have occurred simultaneously with splashes, the protective clothing should be washed off as rapidly as possible and carefully removed.

### V. PROTECTION FOR DECONTAMINATION WORKERS

The Level of Protection worn by decontamination workers is determined by:

- Expected or visible contamination on workers.
- Type of contaminant and associated respiratory and skin hazards.
- Total vapor/gas concentrations in the CRC.
- Particulates and specific inorganic or organic vapors in the CRC.

- Results of swipe tests.
- The presence (or suspected presence) of highly toxic or skin-destructive materials.

#### A. Level C Use

Level C includes a full-face, canister-type air-purifying respirator, hard hat with face shield (if splash is a problem), chemical-resistant boots and gloves, and protective clothing. The body covering recommended is chemical-resistant overalls with an apron, or chemical-resistant overalls and jacket.

A face shield is recommended to protect against splashes because respirators alone may not provide this protection. The respirator should have a canister approved for filtering any specific known contaminants such as ammonia, organic vapors, acid gases, and particulates.

#### B. Level B Use

In situations where site workers may be contaminated with unknowns, highly volatile liquids, or highly toxic materials, decontamination workers should wear Level B protection.

Level B protection includes SCBA, hard hat with face shield, chemical-resistant gloves, and protective covering. The clothing suggested is chemical-resistant overalls, jacket, and a rubber apron. The rubber apron protects the SCBA harness assembly and regulator from becoming contaminated.

### VI. DECONTAMINATION OF EQUIPMENT

Insofar as possible, measures should be taken to prevent contamination of sampling and monitoring equipment. Sampling devices become contaminated, but monitoring instruments, unless they are splashed, usually do not. Once contaminated, instruments are difficult to clean without damaging them. Any delicate instrument which cannot be decontaminated easily should be protected while it is being used. It should be bagged, and the bag taped and secured around the instrument. Openings are made in the bag for sample intake.

#### A. Decontamination Procedures

##### 1. Sampling devices

Sampling devices require special cleaning. The EPA Regional Laboratories can provide information on proper decontamination methods.

## 2. Tools

Wooden tools are difficult to decontaminate because they absorb chemicals. They should be kept on site and handled only by protected workers. At the end of the response, wooden tools should be discarded. For decontaminating other tools, Regional Laboratories should be consulted.

## 3. Respirators

Certain parts of contaminated respirators, such as the harness assembly and leather or cloth components, are difficult to decontaminate. If grossly contaminated, they may have to be discarded. Rubber components can be soaked in soap and water and scrubbed with a brush. Regulators must be maintained according to manufacturer's recommendations. Persons responsible for decontaminating respirators should be thoroughly trained in respirator maintenance.

## 4. Heavy Equipment

Bulldozers, trucks, back-hoes, bulking chambers, and other heavy equipment are difficult to decontaminate. The method generally used is to wash them with water under high pressure and/or to scrub accessible parts with detergent/water solution under pressure, if possible. In some cases, shovels, scoops, and lifts have been sand blasted or steam cleaned. Particular care must be given to those components in direct contact with contaminants such as tires and scoops. Swipe tests should be utilized to measure effectiveness.

## B. Sanitizing of Personnel Protective Equipment

Respirators, reusable protective clothing, and other personal articles not only must be decontaminated before being reused, but also sanitized. The inside of masks and clothing becomes soiled due to exhalation, body oils, and perspiration. The manufacturer's instructions should be used to sanitize the respirator mask. If practical, protective clothing should be machine washed after a thorough decontamination; otherwise it must be cleaned by hand.

## C. Persistent Contamination

In some instances, clothing and equipment will become contaminated with substances that cannot be removed by normal decontamination procedures. A solvent may be used to remove such contamination from equipment if it does not destroy or degrade the protective material. If persistent contamination is expected, disposable garments should be used. Testing for persistent contamination of protective clothing and appropriate decontamination must be done by qualified laboratory personnel.

#### D. Disposal of Contaminated Materials

All materials and equipment used for decontamination must be disposed of properly. Clothing, tools, buckets, brushes, and all other equipment that is contaminated must be secured in drums or other containers and labeled. Clothing not completely decontaminated on-site should be secured in plastic bags before being removed from the site.

Contaminated wash and rinse solutions should be contained by using step-in-containers (for example, child's wading pool) to hold spent solutions. Another containment method is to dig a trench about 4 inches deep and line it with plastic. In both cases the spent solutions are transferred to drums, which are labeled and disposed of with other substances on site.

#### VII. ANNEXES

Annex 1, 2, and 3 describe basic decontamination procedures for a worker wearing Level A, B, or C protection. The basic decontamination lines (Situation 1), consisting of approximately 19 stations, are almost identical except for changes necessitated by different protective clothing or respirators. For each annex, three specific situations are described in which the basic (or full decontamination) procedure is changed to take into account differences in the extent of contamination, the accompanying changes in equipment worn, and other factors. The situations illustrate decontamination setups based on known or assumed conditions at an incident. Many other variations are possible.

Annex 4 describes a minimum layout for personnel decontamination. The number of individual stations have been reduced. Although the decontamination equipment and amount of space required is less than needed in the procedures previously described, there is also a much higher probability of cross-contamination.



## EQUIPMENT DECONTAMINATION

### I. GENERAL

Although contamination avoidance is the best posture to adopt at a hazardous material site, certain equipment used in remedial actions or sampling will unavoidably become contaminated. These items must either be properly decontaminated before being removed from the site or in the case in sampling equipment thoroughly cleaned before the next use. Wherever possible, disposable sampling equipment should be utilized to minimize the quantities of equipment to be cleaned and volume of decontaminants and rinse solutions to be disposed of. Likewise, disposable plastic tarpaulins can be placed over certain items of equipment to minimize subsequent cleaning.

The decontamination of vehicles and large pieces of equipment, such as pumps, must be done on a wash pad constructed so that cleaning solutions and wash water can be recycled or collected for later disposal. A thorough inspection of equipment, supplemented by a swipe test is appropriate, should be the governing factor for length and method of decontamination. It is important that all portions of the equipment including the under carriage, chassis, and cab be thoroughly cleaned. Air filters on equipment utilized in or around the exclusionary zone should be considered highly contaminated and removed and replaced prior to leaving the site. Porous items such as wooden truck beds, cloth hoses, and wooden handles cannot, in many instances, be properly cleaned.

Steam cleaning or high pressure spraying utilizing water with a general purpose low sudsing soap or detergent, to improve wetting effects, is the decontamination method of choice. Physical scrubbing by disposable or easily decontaminated brushes may be necessary to loosen materials. In most instances hot water is more effective than cold. Flushing should be done under high pressure, taking care not to damage items on the equipment such as dials and gauges and loosely hanging wires or hoses.

### II. DECONTAMINANTS

As stated above, steam or hot water with detergent is the decontaminant of choice. However, in some cases, it may be necessary to utilize a special solution or combination of solutions to affect a thorough decontamination. It is important that whatever decontaminant is utilized, its possible reactivity and suitability for the hazardous materials involved be carefully evaluated. Other general decontaminants that might be utilized are categorized in the accompanying table. Additional specialized decontaminants that may be considered include: ethanol, acetone and solvents such as 1, 1, 1-trichloroethane for small items used in sampling; supertropical bleach (STB); DS2, a mixture of diethylenetriamine (70%), ethylene glycol monmethyl ether (28%), and sodium hydroxide (2%); sodium hydroxide (caustic soda); chelating agents such as EDTA, citric acid, tartaric acid and oxalic acid. Biological contaminants have been decontaminated utilizing: betapropiolactone (BPL); formaldehyde solution; ethylene oxide-fluorinated hydrocarbon mixture; peracetic acid; and strong bleaches and caustics. These decontaminants all require special care in their handling and use.

DECON SOLUTION

REMARKS

1. Sodium Carbonate  
(Washing Soda) 5% - 10% aqueous solution, good water softening agent, effective for inorganic acids
2. Sodium Bicarbonate  
(Baking Soda) 5% - 10% aqueous solution, amphoteric - effective with most acids and bases
3. Trisodium Phosphate  
(TSP, Oakite) 5% aqueous solution, good water softening agent - detergent, general rinse solution
4. Combination An aqueous solution of 5% Sodium Carbonate and 5% Trisodium Phosphate
5. Calcium Hypochlorite  
(HTH) 10% aqueous solution, disinfectant, bleaching and oxidizing agent care required in storage, mixing and application

## ANNEX 1

### LEVEL A DECONTAMINATION

#### A. EQUIPMENT WORN

The full decontamination procedure outlined is for workers wearing Level A protection (with taped joints between gloves, boots, and suit) consisting of:

- Fully encapsulating suit with integral boots and gloves.
- Self-contained breathing apparatus.
- Hard hat (optional).
- Chemical-resistant, steel toe and shank boots.
- Boot covers.
- Inner and outer gloves.

#### B. PROCEDURE FOR FULL DECONTAMINATION

##### Station 1: Segregated Equipment Drop

Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths or in different containers with plastic liners. Each will be contaminated to a different degree. Segregation at the drop reduces the probability of cross-contamination.

Equipment: various size containers  
plastic liners  
plastic drop cloths

##### Station 2: Boot Cover and Glove Wash

Scrub outer boot covers and gloves with decon solution or detergent/water.

Equipment: container (20-30 gallons)  
decon solution  
or  
detergent water  
2-3 long-handle, soft-bristle scrub brushes

A diagram showing a concave mirror on the left. Five parallel horizontal dashed lines representing light rays travel from right to left towards the mirror. After reflecting off the mirror's surface, the rays converge and meet at a single point on the principal axis to the right of the mirror.

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Equipment: container (30-50 gallons)  
or  
high-pressure spray unit  
water  
2-3 long-handle, soft-bristle scrub brushes

Station 9: Tank Change

If worker leaves Exclusion Zone to change air tank, this is the last step in the decontamination procedure. Worker's air tank is exchanged, new outer gloves and boots covers donned, and joints taped. Worker then returns to duty.

Equipment: air tanks  
tape  
boot covers  
gloves

Station 10: Safety Boot Removal

Remove safety boots and deposit in container with plastic liner.

Equipment: container (30-50 gallons)  
plastic liners  
bench or stool  
boot jack

Station 11: Fully Encapsulating Suit and Hard Hat Removal

With assistance of helper, remove fully encapsulating suit (and hard hat). Hang suits on rack or lay out on drop cloths.

Equipment: rack  
drop cloths  
bench or stool

Station 12: SCBA Backpack Removal

While still wearing facepiece, remove backpack and place on table. Disconnect hose from regulator valve and proceed to next station.

Equipment: table

Station 13: Inner Glove Wash

Wash with decon solution or detergent/water that will not harm skin. Repeat as many times as necessary.

Equipment: basin or bucket  
decon solution  
or  
detergent/water  
small table

Station 14: Inner Glove Rinse

Rinse with water. Repeat as many times as necessary.

Equipment: water  
basin or bucket  
small table

Station 15: Facepiece Removal

Remove facepiece. Deposit in container with plastic liner. Avoid touching face with fingers.

Equipment: container (30-50 gallons)  
plastic liners

Station 16: Inner Glove Removal

Remove inner gloves and deposit in container with plastic liner.

Equipment: container (20-30 gallons)  
plastic liners

Station 17: Inner Clothing Removal

Remove clothing soaked with perspiration. Place in container with plastic liner. Do not wear inner clothing off-site since there is a possibility that small amounts of contaminants might have been transferred in removing fully encapsulating suit.

Equipment: container (30-50 gallons)  
plastic liners

Station 18: Field Wash

Shower if highly toxic, skin-corrosive or skin-absorbable materials are known or suspected to be present. Wash hands and face if shower is not available.

Equipment: water  
soap  
small table  
basin or bucket  
field showers  
towels

Station 19: Redress

Put on clean clothes. A dressing trailer is needed in inclement weather.

Equipment: tables  
chairs  
lockers  
clothes

C. FULL DECONTAMINATION (SIT. 1) AND THREE MODIFICATIONS

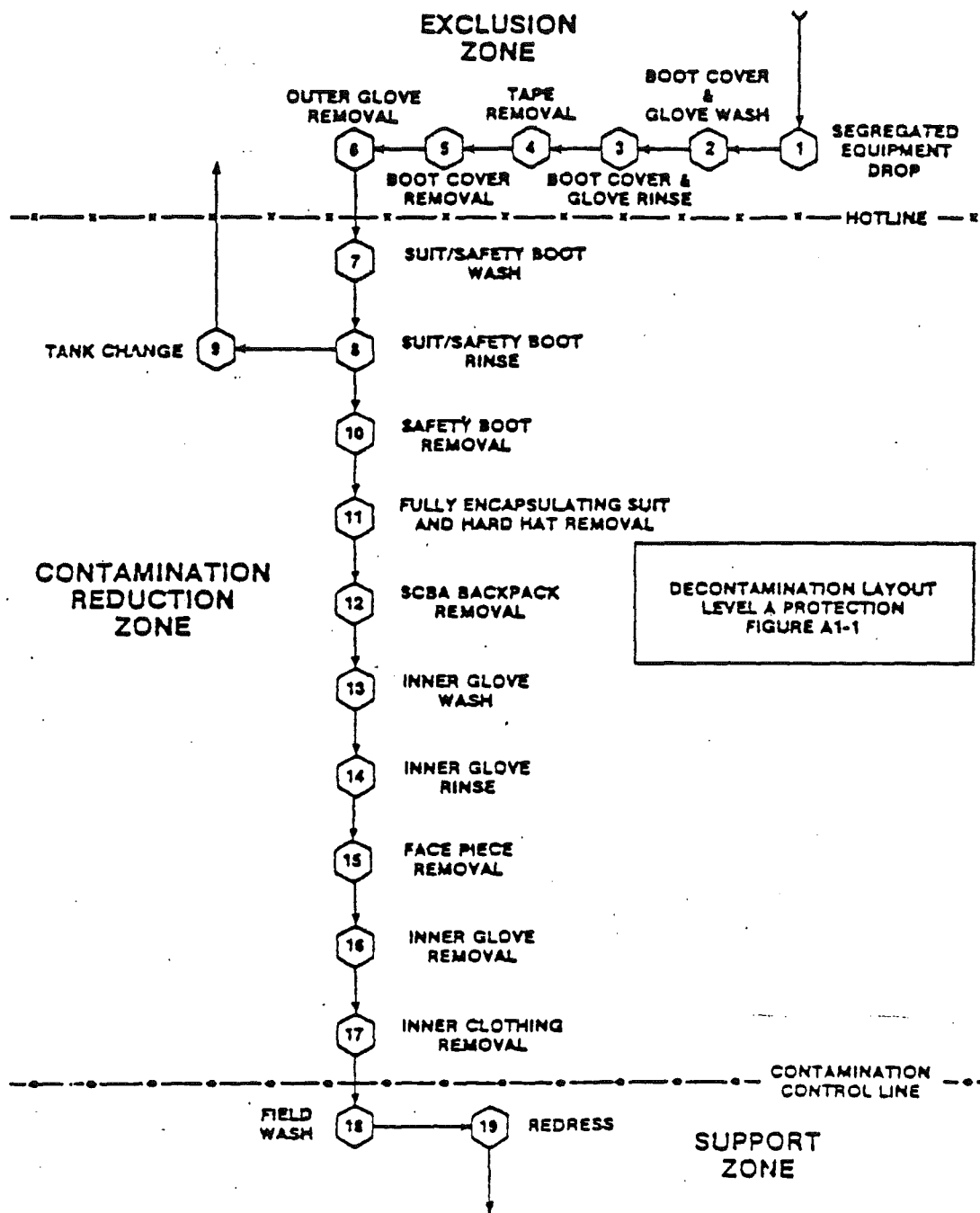
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Situation 1: The individual entering the Contamination Reduction Corridor is observed to be grossly contaminated or extremely toxic substances are known or suspected to be present.

Situation 2: Same as Situation 1 except individual needs new air tank and will return to Exclusion Zone.

Situation 3: Individual entering the CRC is expected to be minimally contaminated. Extremely toxic or skin-corrosive materials are not present. No outer gloves or boot covers are worn. Inner gloves are not contaminated.

Situation 4: Same as Situation 3 except individual needs new air tank and will return to Exclusion Zone.





## ANNEX 2

### LEVEL B DECONTAMINATION

#### A. EQUIPMENT WORN

The full decontamination procedure outlined is for workers wearing Level B protection (with taped joints between gloves, boot, and suit) consisting of:

- One-piece, hooded, chemical-resistant splash suit.
- Self-contained breathing apparatus.
- Hard hat.
- Chemical-resistant, steel toe and shank boots.
- Boot covers
- Inner and outer gloves.

#### B. PROCEDURE FOR FULL DECONTAMINATION

##### Station 1: Segregated Equipment Drop

Deposit equipment used on-site (tools, sampling devices and containers monitoring instruments, radios, clipboards, etc.) on plastic drop cloths or in different containers with plastic liners. Each will be contaminated to a different degree. Segregation at the drop reduces the probability of cross-contamination.

Equipment: various size containers  
plastic liners  
plastic drop cloths

##### Station 2: Boot Cover and Glove Wash

Scrub outer boot covers and gloves with decon solution or detergent/water.

Equipment: container (20-30 gallons)  
decon solution  
or  
detergent water  
2-3 long-handle, soft-bristle scrub brushes



Station 8: Suit/SCBA/Boot/Glove Rinse

Rinse off decon solution or detergent/water using copious amounts of water. Repeat as many times as necessary.

Equipment: container (30-50 gallons)  
                    or  
                    high-pressure spray unit  
                    water  
                    small buckets  
                    2-3 long-handle, soft-bristle scrub brushes  
                    sponges or cloths

Station 9: Tank Change

If worker leaves Exclusion Zone to change air tank, this is the last step in the decontamination procedure. Worker's air tank is exchanged, new outer gloves and boots covers donned, and joints taped. Worker returns to duty.

Equipment: air tanks  
                    tape  
                    boot covers  
                    gloves

Station 10: Safety Boot Removal

Remove safety boots and deposit in container with plastic liner.

Equipment: container (30-50 gallons)  
                    plastic liners  
                    bench or stool  
                    boot jack

Station 11: SCBA Backpack Removal

While still wearing facepiece, remove backpack and place on table. Disconnect hose from regulator valve and proceed to next station.

Equipment: table

Station 12: Splash Suit Removal

With assistance of helper, remove splash suit. Deposit in container with plastic liner.

Equipment: container (30-50 gallons)  
                    plastic liners  
                    bench or stool

Station 13: Inner Glove Wash

Wash inner gloves with decon solution or detergent/water that will not harm skin. Repeat as many times as necessary.

Equipment: decon solution  
                  or  
                  detergent/water  
                  basin or bucket  
                  small table

Station 14: Inner Glove Rinse

Rinse inner gloves with water. Repeat as many times as necessary.

Equipment: water  
                  basin or bucket  
                  small table

Station 15: Facepiece Removal

Remove facepiece. Avoid touching face with gloves. Deposit in container with plastic liner.

Equipment: container (30-50 gallons)  
                  plastic liners

Station 16: Inner Glove Removal

Remove inner gloves and deposit in container with plastic liner.

Equipment: container (20-30 gallons)  
                  plastic liners

Station 17: Inner Clothing Removal

Remove clothing soaked with perspiration. Place in container with plastic liner. Do not wear inner clothing off-site since there is a possibility small amounts of contaminants might have been transferred in removing fully encapsulating suit.

Equipment: container (30-50 gallons)  
                  plastic liners

Station 18: Field Wash

Shower if highly toxic, skin-corrosive, or skin-absorbable materials are known or suspected to be present. Wash hands and face if shower is not available.

Equipment: water  
                  soap

small tables  
basins or buckets  
field showers

Station 19: Redress

Put on clean clothes. A dressing trailer is needed in inclement weather.

Equipment: tables  
chairs  
lockers  
clothes

C. FULL DECONTAMINATION (SIT. 1) AND THREE MODIFICATIONS

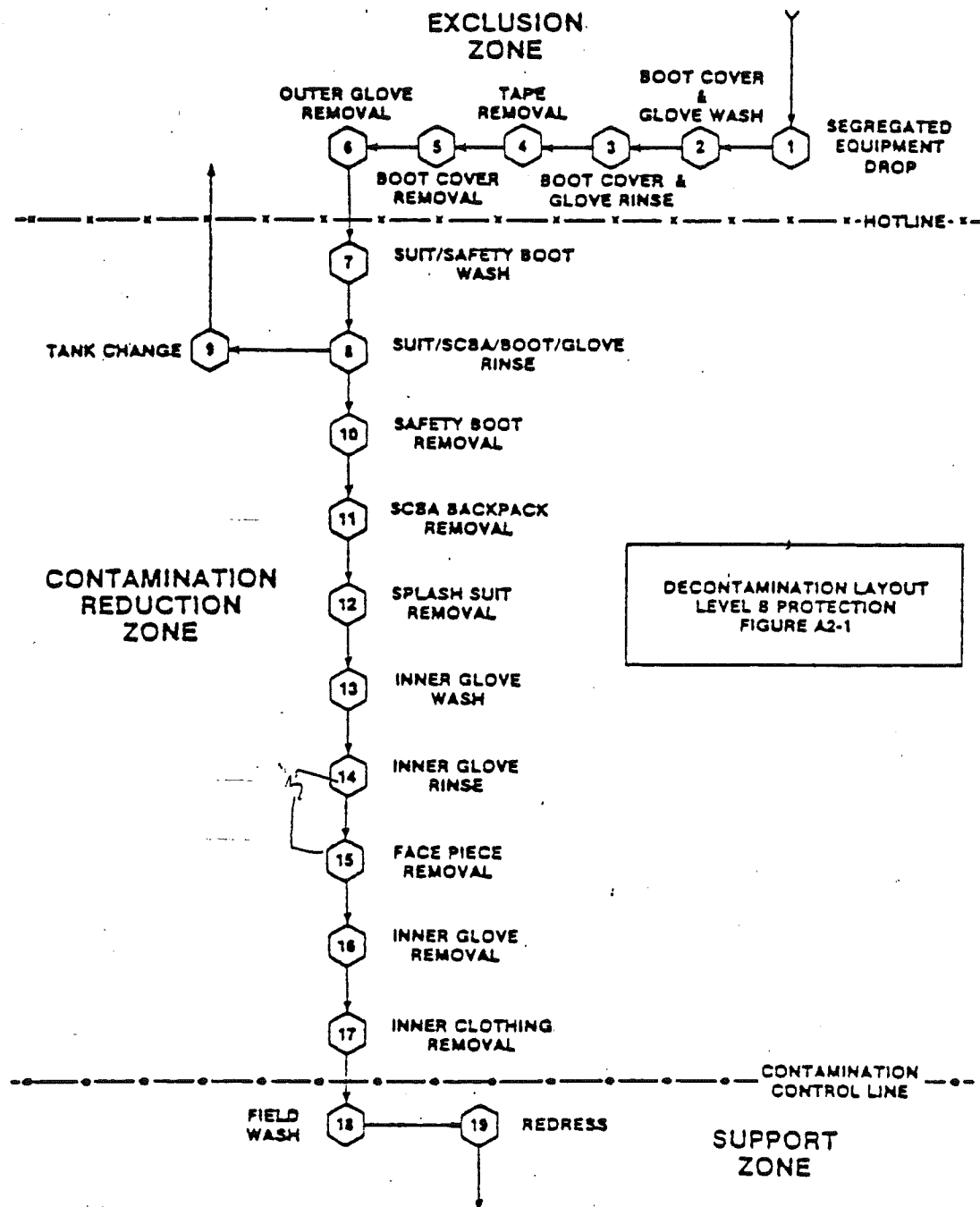
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3	X						X	X		X	X	X			X	X	X	X	
4	X						X	X	X										

Situation 1: The individual entering the Contamination Reduction Corridor is observed to be grossly contaminated or extremely toxic substances are known or suspected to be present.

Situation 2: Same as Situation 1 except individual needs new air tank and will return to Exclusion Zone.

Situation 3: Individual entering the CRC is expected to be minimally contaminated. Extremely toxic or skin-corrosive materials are not present. No outer gloves or boot covers are worn. Inner gloves are not contaminated.

Situation 4: Same as Situation 3 except individual needs new air tank and will return to Exclusion Zone.



## ANNEX 3

### LEVEL C DECONTAMINATION

#### A. EQUIPMENT WORN

The full decontamination procedure outlined is for workers wearing Level C protection (with taped joints between gloves, boots, and suit) consisting of:

- One-piece, hooded, chemical-resistant splash suit.
- Canister equipped, full-face mask.
- Hard hat.
- Chemical-resistant, steel toe and shank boots.
- Boot covers.
- Inner and outer gloves.

#### B. PROCEDURE FOR FULL DECONTAMINATION

##### Station 1: Segregated Equipment Drop

Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths or in different containers with plastic liners. Each will be contaminated to a different degree. Segregation at the drop reduces the probability of cross-contamination.

Equipment: various size containers  
plastic liners  
plastic drop cloths

##### Station 2: Boot Cover and Glove Wash

Scrub outer boot covers and gloves with decon solution or detergent/water.

Equipment: container (20-30 gallons)  
decon solution  
or  
detergent water  
2-3 long-handle, soft-bristle scrub brushes

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Rinse off decon solution or detergent/water using copious amounts of water. Repeat as many times as necessary.



2-3 long-handle, soft-bristle scrub brushes

### Station 9: Canister or Mask Change

If worker leaves Exclusion Zone to change canister (or mask), this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer gloves and boots covers donned, and joints taped. Worker returns to duty.

gloves

## Station 10: Safety Boot Removal

Remove safety boots and deposit in container with plastic liner.

boot jack

### Station 11: Splash Suit Removal

With assistance of helper, remove splash suit. Deposit in container with plastic liner.

plastic liner

### Station 12: Inner Glove Wash

Wash inner gloves with decon solution or detergent/water that will not harm skin. Repeat as many times as necessary.

basin or bucket

### Station 13: Inner Glove Rinse

Rinse inner gloves with water. Repeat as many times as necessary.

Equipment: water  
basin or bucket  
small table

Station 14: Facepiece Removal

Remove facepiece. Avoid touching face with gloves. Deposit facepiece in container with plastic liner.

Equipment: container (30-50 gallons)  
plastic liners

Station 15: Inner Glove Removal

Remove inner gloves and deposit in container with plastic liner.

Equipment: container (20-30 gallons)  
plastic liners

Station 16: Inner Clothing Removal

Remove clothing soaked with perspiration. Place in container with plastic liner. Do not wear inner clothing off-site since there is a possibility small amounts of contaminants might have been transferred in removing fully encapsulating suit.

Equipment: container (30-50 gallons)  
plastic liners

Station 17: Field Wash

Shower if highly toxic, skin-corrosive or skin-absorbable materials are known or suspected to be present. Wash hands and face if shower is not available.

Equipment: water  
soap  
tables  
wash basins/buckets  
field showers

Station 18: Redress

Put on clean clothes. A dressing trailer is needed in inclement weather.

Equipment: tables  
chairs  
lockers  
clothes

C. FULL DECONTAMINATION (SIT. 1) AND THREE MODIFICATIONS

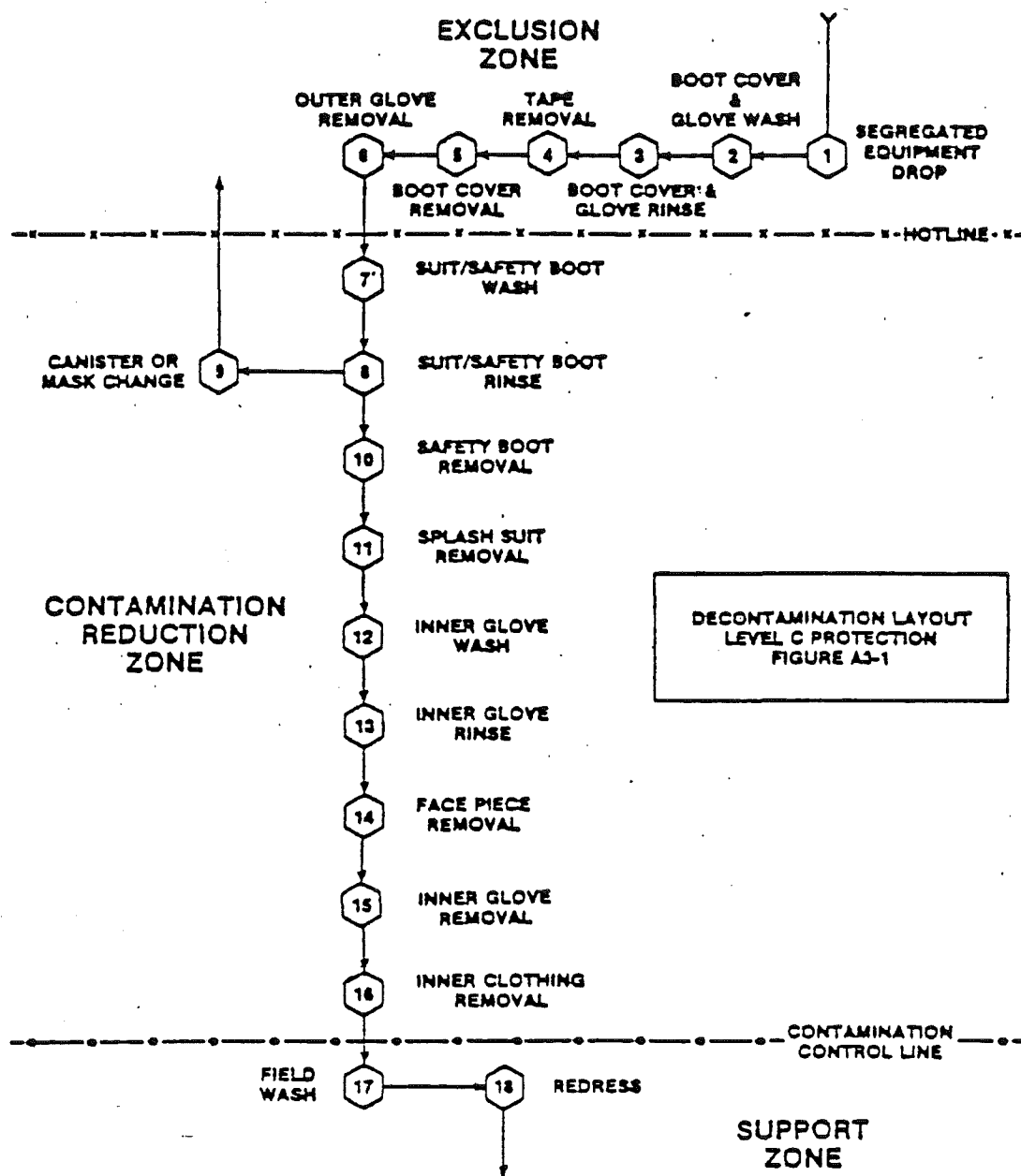
S I T	STATION NUMBER																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X	X									
3	X						X	X		X	X			X	X	X	X	
4	X						X	X	X									

Situation 1: The individual entering the Contamination Reduction Corridor is observed to be grossly contaminated or extremely skin-corrosive substances are known or suspected to be present.

Situation 2: Same as Situation 1 except individual needs new canister or mask and will return to Exclusion Zone.

Situation 3: Individual entering the CRC is expected to be minimally contaminated. Extremely skin-corrosive materials are not present. No outer gloves or boot covers are worn. Inner gloves are not contaminated.

Situation 4: Same as Situation 3 except individual needs new canister or mask and will return to Exclusion Zone.



## ANNEX 4

### LEVEL A DECONTAMINATION, MINIMUM LAYOUT

#### A. EQUIPMENT WORN

The decontamination procedure outlined is for workers wearing Level A protection (with taped joints between gloves, boots, and suit) consisting of:

- Fully encapsulating suit with integral boots and gloves.
- Self-contained breathing apparatus.
- Hard hat (optional).
- Chemical-resistant, steel toe and shank boots.
- Boot covers.
- Inner and outer gloves.

#### B. PROCEDURE FOR FULL DECONTAMINATION

##### Station 1: Segregated Equipment Drop

Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths or in different containers with plastic liners. Each will be contaminated to a different degree. Segregation at the drop reduces the probability of cross-contamination.

Equipment: various size containers  
plastic liners  
plastic drop clothes

##### Station 2: Outer Garment, Boots, and Gloves Wash and Rinse

Scrub outer boots, outer gloves, and fully-encapsulating suit with decon solution or detergent water. Rinse off using copious amounts of water.

Equipment: containers (30-50 gallons)  
decon solution  
or  
detergent water  
rinse water  
2-3 long-handle, soft-bristle scrub brushes

Station 3: Outer Boot and Glove Removal

Remove outer boots and gloves. Deposit in container with plastic liner.

Equipment: container (30-50 gallons)  
plastic liners  
bench or stool

Station 4: Tank Change

If worker leaves Exclusion Zone to change air tank, this is the last step in the decontamination procedure. Worker's air tank is exchanged, new outer gloves and boot covers donned, joints taped, and worker returns to duty.

Equipment: air tanks  
tape  
boot covers  
gloves

Station 5: Boot, Gloves, and Outer Garment Removal

Boots, fully-encapsulating suit, and inner gloves removed and deposited in separate containers lined with plastic.

Equipment: containers (30-50 gallons)  
plastic liners  
bench or stool

Station 6: SCBA Removal

SCBA backpack and facepiece is removed. Hands and face are thoroughly washed. SCBA deposited on plastic sheets.

Equipment: plastic sheets  
basin or bucket  
soap and towels  
bench

Station 7: Field Wash

Thoroughly wash hands and face. Shower as soon as possible.

Equipment: water  
soap  
tables  
wash basin/bucket

